DOCUMENT RESUME

ED 446 991 SE 064 296

AUTHOR	Colombo, Luann; Ransick, Kristina; Recio, Belinda
TITLE	NOVA Spring 1999 Teacher's Guide.
INSTITUTION	WGBH-TV, Boston, MA.
SPONS AGENCY	Northwestern Mutual Life Insurance Co., Milwaukee, WI.
PUB DATE	1999-00-00
NOTE	47p.; Published semiannually. Also funded by the Park Foundation and iomega.
AVAILABLE FROM	NOVA Teacher's Guide, WGBH, 125 Western Avenue, Boston, MA 02134; e-mail: wgbh_materials_request@wgbh.org.
PUB TYPE	Guides - Classroom - Teacher (052)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Biological Sciences; Elementary Secondary Education; *Integrated Activities; *Mathematics Education; Physical Sciences; Relevance (Education); *Science Education; Social Studies
IDENTIFIERS	NOVA (Television Series)

ABSTRACT

This teacher's guide complements six programs that aired on the Public Broadcasting System (PBS) in the spring of 1999. Programs include: (1) "Surviving AIDS"; (2) "Secrets of Making Money"; (3) "Escape!: Fire"; (4) "Escape!: Car Crash"; (5) "Volcanoes of the Deep"; and (6) "Odyssey of Life: Part 1. The Ultimate Journey". It provides activity set-ups related to the programs and what to do before and after watching the programs. Activity sheets, answers for the activity sheets, and additional resources are also included. (ASK)

Reproductions supplied by EDRS are the best that can be made
from the original document.

Major funding is provided by PARK FOUNDATION Northwestern Mutual Life

ED 446 991

SE064296

NOVA

Spring 1999 Teacher's Guide

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

S. Lashmore

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Surviving AIDS, page 6

The Park Foundation is committed to education and quality television. We are pleased to be able to advance the work of NOVA, the preeminent television series in science education. As you know, through study of science, young people acquire skills, knowledge, and – most of all – an intellectual curiosity.

The NOVA Teacher's Guide serves as an excellent supplement for your use. We are grateful to you for introducing students to the world of science.

Heartiest congratulations to NOVA on its 25th anniversary season.

PARK
FOUNDATION

Contents & Broadcast Schedule

Page		Earth & Space Science	General Science	Life Science	Physical Science	Social Studies	NOVA Activity
2	**NOVA in the Classroom** Find out how to use this guide, what's new on NOVA Online and how NOVA is being used in classrooms around the nation.						
	Everest: The Death Zone* (R) Week of January 5		★	★	★		
	The Beast of Loch Ness* Week of January 12		★	★	★		
	Submarines, Secrets and Spies* Week of January 19		★			★	
	Mysterious Crash of Flight 201 (R)** Week of January 26		★		★		
6	**Surviving AIDS*** Week of February 2			★		★	
10	**Secrets of Making Money* (R)** Week of February 9		★			★	
	ESCAPE! Because Accidents Happen* (4-hour Special)		★		★	★	
14	**Fire**		★		★	★	
18	**Car Crash**		★		★	★	
	Week of February 16 (2-hour Broadcast)		★		★	★	
	Plane Crash		★		★	★	
	Abandon Ship		★		★	★	
	Week of February 17 (Special Wednesday 2-hour Broadcast)						
	Battle Alert In the Gulf* Week of February 23		★			★	
	Warnings from the Ice* (R) Week of March 2	★					
	Fastest Planes in the Sky (R)** Week of March 23		★		★		
24	**Volcanoes of the Deep*** Week of March 30	★		★			
	Warriors of the Amazon* (R) Week of April 6		★			★	
	Bombing of America* (R) Week of April 13		★		★	★	
	Lost City of Arabia* (R) Week of April 20		★			★	
	Kaboom!* (R) Week of April 27		★		★		
	A Man, A Plan, A Canal: Panama* Week of May 11		★			★	
28	**Odyssey of Life: Part I The Ultimate Journey* (R)** Week of May 18			★			
	Odyssey of Life: Part II The Unknown World* (R) Week of May 25			★			
	Odyssey of Life: Part III The Photographer's Secrets* (R) Week of June 1		★	★			
32	**NOVA Video Catalog**						
40	**Ordering Guides and Transcripts**						

Visit us at our booth at the Boston NSTA Conference! March 25–28, 1999

Lesson within this guide.

Lesson online at: **http://www.pbs.org/nova/teachers/teachersguide.html**

Because of schedule changes and space constraints, some NOVA programs do not have lessons.

* one-year off-air taping rights

** seven-day off-air taping rights

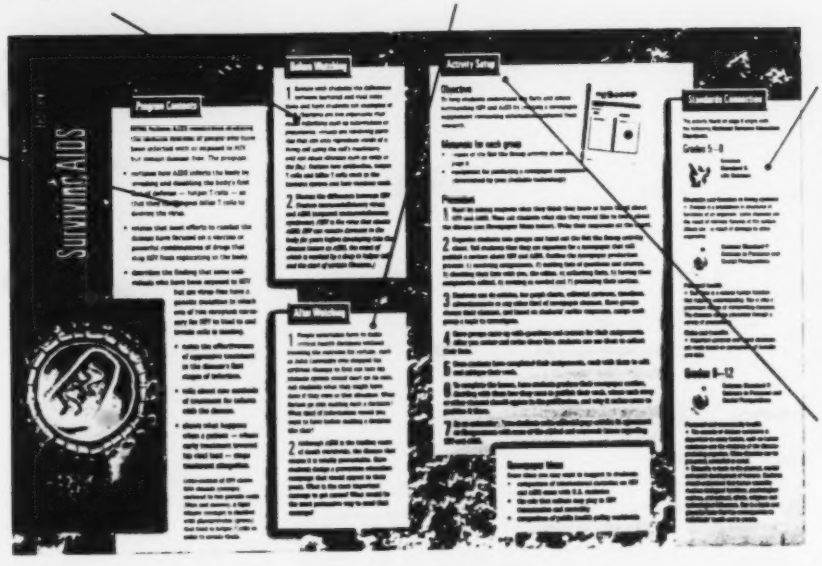
(R) indicates a repeat program from a previous NOVA season.

Using This Guide

Before Watching
Identifies main ideas in the program and suggests discussion questions and activities to prompt students' prior knowledge and alert students to important points to look for while watching.

After Watching
Gives ideas for reviewing the program and for following up on issues that were raised in the Before Watching section.

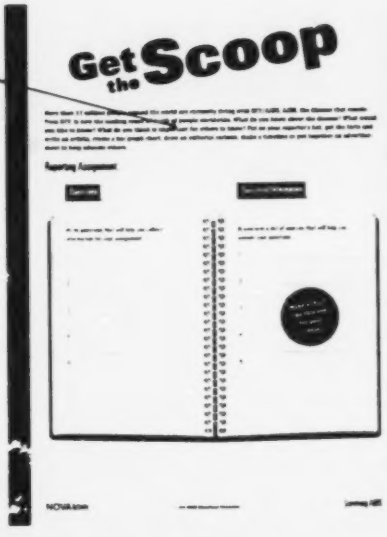
Program Contents
Summarizes the major topics, events and findings explored in the program.

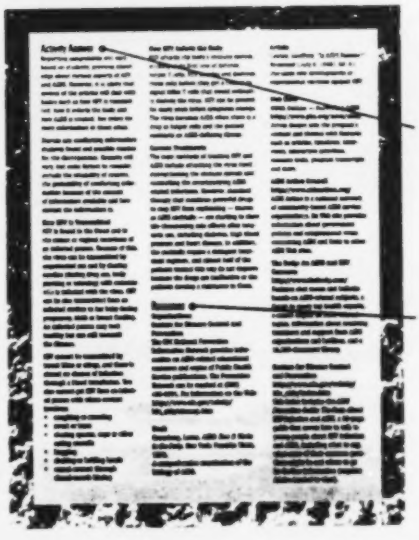


Standards Connection
Identifies connections between the student activity and the **National Science Education Standards** and the **Curriculum and Evaluation Standards for School Mathematics.**

Activity Setup
Outlines the procedure and offers ideas for facilitating the student activity.

Student Activity (Reproducible)
Guides students through the activity with a materials list, procedure steps and critical thinking questions.





Activity Answer
Outlines expected outcomes for the activity, further explanation of science concepts and tips for extending the activity.

Resources
Lists annotated references of books, articles and Web sites.

NOVA in the Classroom

Visit Us at NOVA Online!

Find Content for Each New Program

NOVA Online brings you Web sites to accompany all of the new spring programs. See **Resources** in each lesson for details or visit our Web site at: **http://www.pbs.org/nova**

Join the Adventure!

Get ready for the next NOVA/PBS Online Adventure, which will follow an attempt by archaeologists and engineers to raise an enormous obelisk using only the technology available to the ancient Egyptians. Alongside regular dispatches on the progress of the experiment, your students will also be able to navigate through some of the ancient monuments and temples of the New Kingdom. The adventure will launch in early March. To receive further information, sign up for the teacher's listserve at:
http://www.pbs.org/nova/teachers/listsubscribe.html

Check Out Our Teachers Site

http://www.pbs.org/nova/teachers

This Week on NOVA
This section features a listing of the science articles, features and activities on the Web site that accompany the most recent NOVA program. Brief descriptions and grade-level designations are provided for everything on the site.

Previous Sites
This section provides access by program title or subject area to Web content for previous NOVA programs.

Lesson Ideas
In this section, you'll find ideas from your colleagues and lesson plans from this teacher's guide to help you integrate current and past NOVA programs and NOVA Online Web sites into your curriculum.

Sign Up for Weekly Updates

Would you like to know what's coming up on NOVA each week, both on television and the Web site? Join our mailing list and find out. Each week we'll send you a reminder of the date and title of the following week's broadcast, and what you'll find online to help you integrate the Web into your curriculum. And we'll keep you abreast of any special programs or online adventures we're planning.

Teacher's Guide
Sign up to receive your free teacher's guide by mail.

Online Activities
Click here to go to our activities designed especially for the Internet.

Shop
The shop gives you access to NOVA programs available for purchase and lists other educational products we offer.

Teacher's Exchange
Here you can swap ideas with other teachers about how you use NOVA.

NOVA in the Classroom

Celebrate NOVA's 25th Anniversary . . . and Win an iMac Computer!

Help us to celebrate 25 years of science television on NOVA by letting us know how you use NOVA with your students and topics your students think NOVA should consider for the next 25 years.

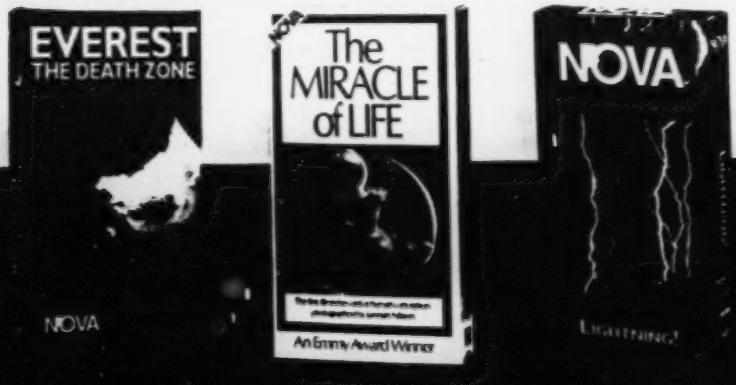
Enter to win by . . .

- telling us how you have used this anniversary season's NOVA programs, *NOVA Teacher's Guide* and/or NOVA Online Web sites in your classroom, and
- having your students tell us what they would like to see on NOVA in the next 25 years.

For contest rules and official entry form visit the **Teachers** area of NOVA Online **(http://www.pbs.org/nova/teachers/)** after January 15, 1999. Entry deadline is May 15, 1999.

NOVA Videos 50% Off

In celebration of NOVA's 25th season, we're offering educators a special on all of our NOVA videos: 50 percent off on orders received by June 30, 1999. In addition, teachers who fill out and send back the business reply card in this guide will be entered into a drawing to win a free one-hour NOVA video of their choice. See page 32 for details.



NOVA's 25th anniversary season includes:

Fall 1998
Lost at Sea: The Search for Longitude
Chasing El Niño
Terror in Space
Special Effects: *Titanic* and Beyond
Deadly Shadow of Vesuvius
Ice Mummies (3-Hour Special)
- Frozen in Heaven
- Siberian Ice Maiden
- Return of the Iceman

Leopards of the Night
Supersonic Spies
Venus Unveiled
The Perfect Pearl

Spring 1999
Everest: The Death Zone
The Beast of Loch Ness
Submarines, Secrets, and Spies
Mysterious Crash of Flight 201
Surviving AIDS
Secrets of Making Money
ESCAPE!* (4-hour Special)
- Fire
- Car Crash
- Plane Crash
- Abandon Ship

Battle Alert In the Gulf
Warnings from the Ice
Fastest Planes in the Sky
Volcanoes of the Deep
Warriors of the Amazon
Bombing of America
Lost City of Arabia
Kaboom!
A Man, A Plan, A Canal: Panama

NOVA Featured Teacher

Teaching with Sextants

"How do these things work?"

That was the question that kept coming up during Steven Branting's creative thinking and pre-engineering course two years ago. His students wanted to know how maritime sextants and astrolabes worked.

Which is what led Branting, who teaches at Jenifer Junior High School and Lewiston High School in Idaho, to develop a comprehensive unit around the use of the modern-day marine sextant. With grants from a local company and his school board, Branting created a unit that begins with the history of navigation, and includes material on how to:

- solve problems of grids on curved surfaces
- calibrate sextants to ensure mirror accuracy
- determine and take a local noon shot
- use an ephemeris to find "equation of time" and "declination" for any given date
- calculate latitude and longitude from a local noon sighting
- use an artificial horizon

NOVA's "Lost at Sea: The Search for Longitude," which premiered Fall 1998, was a natural tie-in. Branting uses clips from the program to help students understand the role time-keeping plays in navigation and the need for accurate timepieces.

The materials for Branting's unit include a student handout, classroom transparency set, student and teacher sextants, Internet access (to connect to the U.S. Naval Observatory clock) and a copy of the NOVA video.

Branting, a facilitator of gifted education, has developed several additional uses of the sextant as a teaching tool in mathematics and geology. A sextant can be used:

- as a pelorus, an instrument meant to determine a ship's bearing in relation to a distant object. Turning the sextant to a horizontal position, this capability can be adapted to calculate the distance to an object using the trigonometric tangent function.
- to calculate the distance to tree leaves that have created images of the Sun on the ground.
- to measure the angle of repose for talus slopes (the slopes of rock at the base of a cliff) in basalt formations.

Branting's unit can be found on NOVA Online's Teacher's Exchange at: **http://www.pbs.org/nova/teachers/ideas/longitude.html**

Using their sextants to take a sun shot at local noon are (from left) Nick Gauger, Marissa Williams, Alex Mann, Tracy Fickenwirth, teacher Steven Branting and Sarah Baer.

More on Longitude

For another cross-curricular unit on longitude, "Navigating Around the World by Observing the Sun" (by James I. Sammons of Jamestown School in Rhode Island), see the Teacher's Exchange at the address listed at right.

Become a NOVA Featured Teacher

We'd like to hear from YOU! Tell us how you're using a NOVA program or NOVA Online in your classroom. Send your comments to: **http://www.pbs.org/nova/teachers/teacherex.html** and we'll post them in our Lesson Ideas section. Or send your ideas to:

Jenny Lisle
WGBH, 125 Western Avenue
Boston, MA 02134

If we choose to feature your classroom in the *NOVA Teacher's Guide*, we'll send you and your students six free NOVA videos or two Classroom Field Trip kits of your choice.

Airs the week of February 2, 1999

Surviving AIDS

Program Contents:

NOVA follows AIDS researchers studying the immune systems of people who have been infected with or exposed to HIV but remain disease-free. The program:

- outlines how AIDS infects the body by invading and disabling the body's first line of defense — helper T cells — so that they can't signal killer T cells to destroy the virus.
- relates that most efforts to combat the disease have focused on a vaccine or powerful combinations of drugs that stop HIV from replicating in the body.
- describes the finding that some individuals who have been exposed to HIV but are virus-free have a genetic mutation in which one of two receptors necessary for HIV to bind to and invade cells is missing.
- notes the effectiveness of aggressive treatment in the disease's first stages of infection.
- tells about new methods of treatment for infants with the disease.
- shows what happens when a patient — whose early treatment lowered his viral load — stops treatment altogether.

Cross-section of HIV shows RNA strands (orange) enclosed in two protein coats (blue and mauve). A lipid bilayer (orange) is studded with glycoproteins (green) that bind to helper T cells in order to invade them.

Before Watching

1 Review with students the difference between bacterial and viral infections and have students list examples of each *(bacteria are live organisms that cause infections such as tuberculosis or pneumonia; viruses are nonliving particles that can only reproduce inside of a living cell using the cell's machinery and can cause illnesses such as colds or the flu)*. Outline how antibodies, helper T cells and killer T cells work in the immune system and how vaccines work.

2 Discuss the difference between HIV (human immunodeficiency virus) and AIDS (acquired immunodeficiency syndrome) ***(HIV is the virus that causes AIDS; HIV can remain dormant in the body for years before developing into the disease known as AIDS, the onset of which is marked by a drop in helper cells and the start of certain illnesses.)***

After Watching

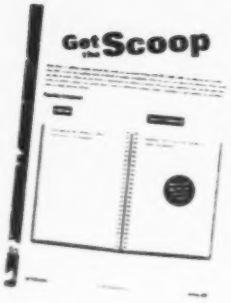
1 People sometimes have to make critical health decisions without knowing the outcome for certain, such as John Cerevasky who stopped his antiviral therapy to find out how his immune system would react on its own. Ask students what they might have done if they were in that situation. What factors go into making such a decision? What kind of information would you want to have before making a decision like that?

2 Although AIDS is the leading cause of death worldwide, the disease that causes it is totally preventable. Have students design a prevention education campaign that would appeal to their peers. What is the most important message to get across? What would be the most persuasive way to send that message?

Activity Setup

Objective

To help students understand the facts and issues surrounding HIV and AIDS by creating a newspaper supplement containing information gathered from research.



Materials for each group

- copies of the **Get the Scoop** activity sheet on page 8
- equipment for producing a newspaper supplement (determined by your available technology)

Procedure

1 Start by asking students what they think they know or have heard about HIV and AIDS. Then ask students what else they would like to know about the disease (see **Newspaper Ideas** below). Write their responses on the board.

2 Organize students into groups and hand out the **Get the Scoop** activity sheet. Tell students that they are reporters for a newspaper that will publish a section about HIV and AIDS. Outline the newspaper production process: 1) receiving assignments, 2) making lists of questions and sources, 3) checking their lists with you, the editor, 4) collecting facts, 5) having their assignments edited, 6) revising as needed and 7) producing their section.

3 Students can do articles, bar graph charts, editorial cartoons, timelines, advertisements or any other kind of newspaper element. Have groups choose their element, and based on students' earlier responses, assign each group a topic to investigate.

4 Have groups come up with questions and sources for their assignments. After you review and revise these lists, students can use them to collect their facts.

5 Once students have completed their assignments, work with them to edit and critique their work.

6 To complete the lesson, have students produce their newspaper section, deciding with them how they want to publish their work, where each story or other element should appear in the publication, and why it makes sense to position it there.

7 As an **extension,** have students write editorial page articles in agreement or disagreement with some of the ethical and economic issues regarding HIV and AIDS.

Newspaper Ideas

Some ideas you may want to suggest to students:

- comparison of international statistics on HIV and AIDS cases with U.S. statistics
- the role that culture may play in HIV transmission and mortality
- comparison of public health policy worldwide

Standards Connection

The activity found on page 8 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard C: Life Science

Structure and function in living systems

- Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system. Others are the result of damage by other organisms.

Science Standard F: Science in Personal and Social Perspectives

Personal health

- Sex drive is a natural human function that requires understanding. Sex is also a prominent means of transmitting diseases. The diseases can be prevented through a variety of precautions.

Risks and benefits

- Important personal and social decisions are made based on perceptions of benefits and risks.

Grades 9–12

Science Standard F: Science in Personal and Social Perspectives

Personal and community health

- The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled or cured.
- Sexuality is basic to the physical, mental and social development of humans. Students should understand that human sexuality involves biological functions, psychological motives, and cultural, ethnic, religious and technological influences. Sex is a basic and powerful force that has consequences to individuals' health and to society.

Get the Scoop

More than 33 million people around the world are currently living with HIV/AIDS. AIDS, the disease that results from HIV, is now the leading cause of death of people worldwide. What do you know about the disease? What would you like to know? What do you think is important for others to know? Put on your reporter's hat, get the facts and write an article, create a bar graph chart, draw an editorial cartoon, make a timeline or put together an advertisement to help educate others.

Reporting Assignment: _____

Questions

Write questions that will help you collect information for your assignment.

1 _____

2 _____

3 _____

4 _____

5 _____

Sources of Information

Brainstorm a list of sources that will help you answer your questions.

1 _____

2 _____

3 _____

4 _____

5 _____

Make a chart like this one for your ideas

© 1999 WGBH Educational Foundation

Activity Answer

Reporting assignments will vary based on students' previous knowledge about various aspects of HIV and AIDS. However, it is likely that several of the articles will deal with basics such as how HIV is transmitted, how it infects the body and how AIDS is treated. See below for more information in those areas.

Discuss any conflicting information students found and possible reasons for the discrepancies. Reasons will vary, but some factors to consider include the reliability of sources, the probability of conflicting information because of the amount of information available and how current the information is.

How HIV is Transmitted

HIV is found in the blood and in the semen or vaginal secretions of an infected person. Because of this, the virus can be transmitted by unprotected sex and by sharing needles (during drug use, body piercing or tatooing) with someone who is infected with the virus. HIV can be also transmitted from an infected mother to her baby during pregnancy, birth or breast feeding. An infected person may look healthy but can still transmit the disease.

HIV cannot be transmitted by insect bites or stings, and there is almost no chance of infection through a blood transfusion. You also cannot get HIV from an infected person with whom contact involves:

- coughing or sneezing
- sweat or tears
- sharing spoons, cups or other eating utensils
- hugging
- shaking or holding hands
- casual contact through closed-mouth kissing

How HIV Infects the Body

HIV attacks the body's immune system, striking at its first line of defense, helper T cells. HIV invades and destroys these cells before they get a chance to signal killer T cells that would ordinarily destroy the virus. HIV can be present for many years before symptoms emerge. The virus becomes AIDS when there is a drop in helper cells and the patient contracts an AIDS-defining illness.

Current Treatments

The main methods of treating HIV and AIDS include attacking the virus itself, strengthening the immune system and controlling the accompanying AIDS-related infections. However, standard therapy that combines powerful drugs to stop HIV from replicating — known as AIDS cocktails — are starting to show life-threatening side effects after long-term use, including diabetes, high blood pressure and heart disease. In addition, the cocktails require a stringent treatment regimen, and almost half of the patients treated this way do not improve because the drugs are ineffective or the patients develop a resistance to them.

Resources

Organizations

Centers for Disease Control and Prevention

The CDC National Prevention Information Network provides information on AIDS-related educational resources and copies of Public Health Service publications. The Prevention Network can be reached at (800) 458-5231. For information on the Web: http://www.cdc.gov/nchstp/hiv_aids/sitemap.htm

Book

Greenberg, Lorna. *AIDS: How It Works in the Body*. New York: Franklin Watts, 1992.

A comprehensive examination of the biology of AIDS.

Article

Cowley, Geoffrey. "Is AIDS Forever?" *Newsweek* (July 6, 1998): 60–61. Discusses new developments in experimental vaccines against HIV.

Web Sites

NOVA Online — Surviving AIDS
http://www.pbs.org/nova/aids/
Delves deeper into the program's content and themes with features such as articles, timelines, interviews, interactive activities, resource links, program transcripts and more.

AIDS Action Council
http://www.aidsaction.org/
AIDS Action is a national network of community-based AIDS service organizations. Its Web site provides information about government policies and congressional votes concerning AIDS and links to other AIDS Web sites.

The Body: An AIDS and HIV Resource
http://www.thebody.com/
Features chat rooms and bulletin boards on AIDS-related subjects, a forum to query top health experts, a search engine on AIDS-related topics, information about receiving treatment and support from AIDS organizations and hotlines, and a 15,000-document library.

Centers for Disease Control and Prevention
http://www.cdc.gov/nchstp/hiv_aids/index.htm
This index includes the *AIDS Prevention Guide: The Facts About HIV Infection and AIDS*, a 26-page guide that covers how to talk to young people about HIV infection and AIDS, including what to say, what some of their common questions might be and where to go for further information (requires Adobe Acrobat to view).

Secrets of Making Money

Airs the week of February 8, 1999

Program Contents

NOVA explains the reasons for the redesign of U.S. paper currency and describes security features that are embedded in the new $100 bill. The program:

- points out that bills with the original design are easy to counterfeit, having been around since 1929 and in circulation worldwide.
- broadly describes the traditional mode of counterfeiting — from creating a negative to printing the bill.
- indicates that the Treasury Department is concerned both with casual counterfeiters — who use color copiers and other modern reprographic equipment — and with professional counterfeiters.
- states that while no single feature will make a bill counterfeit-proof, the Treasury Department hopes that by adding several new features the bill will be more difficult to counterfeit.
- reviews the new features, which include a security thread with numbers on it denoting a bill's value, a watermark, an enlarged portrait, microprinting and color-shifting ink.
- outlines the Treasury Department's endurance tests for bills, including simulating exposure to sun, gasoline, washing, drying and crumpling.

An enlarged portrait is one of several changes in U.S. bills designed to discourage counterfeiting.

Before Watching

1 Organize students into large groups, and give each group a newly designed $20 bill. Have students observe and list the characteristics of the redesigned U.S. currency. To see two of the new security features, have students hold a bill up to the light and look for a security thread embedded in the paper (running through the left side of the bill) and a watermark in the right side of the bill. To see another feature, give them a hand lens or jeweler's loupe to locate the microprinting around the portrait on the front of the bill. As they watch, have students look for features of U.S. and foreign currency that are intended to be difficult to counterfeit.

After Watching

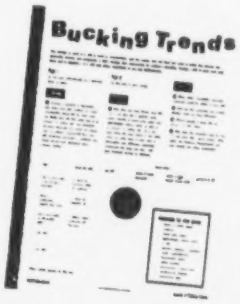
1 Changes to U.S. bills were made to enhance security, not to alter the notes aesthetically. Many countries, however, have highly decorative currency. Bring in or have students bring in currency from other countries to compare with the U.S. bills. Ask students what they think each design element symbolizes. What role do they think aesthetics should play in the design of a country's currency?

Objective

To design an investigation that determines and compares properties of different kinds of materials and to choose a material that is best suited for a particular purpose.

Materials for each group

- copies of the **Bucking Trends** activity sheet on page 12
- sheet of white paper
- scissors
- wood pulp paper
- lightweight cotton cloth
- $1 bill
- pencils, crayons or markers
- chalk, highlighters, fluorescent paint
- safety glasses
- microscope or hand lens
- neodymium magnet
- ultraviolet light*



Procedure

1 Organize students into groups and distribute the **Bucking Trends** activity sheet to each group. In **Part I,** have students consider the aesthetics of bill design by choosing a nation they would like to represent and designing a bill for that nation. If possible, have students bring in samples of foreign currency to review.

2 Have students include any security features they have learned about from the program or others they think of on their own, as well as symbols or pictures they believe represent their chosen country.

3 Once they have designed their bills, have students continue to **Part II.** In this section, students will cut out their designed bills and compare them to same-sized cutouts of other materials and an actual U.S. bill. To conclude, ask students how good a choice is the material used for the U.S. bill and why. Why might the Treasury Department not have chosen other materials?

4 As an **extension,** have students explore a replacement system of currency (such as traveler's checks, stamps, credit cards and plane tickets) and the security features used to deter counterfeiting.

*** CAUTION: Have students wear safety glasses when using the ultraviolet light.**

The activity found on page 12 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.

Grades 9–12

Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise scientific explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

Bucking Trends

The design of each U.S. bill is hard to counterfeit, and the paper and ink that are used to print the money are specially chosen and prepared. A bill's design also represents its nation's identity. Design a bill of your own and then test it against a U.S. bill and other materials to see any differences.

Part I

Do this part individually on a separate sheet of paper.

Procedure

1. Choose a country to represent and draw your own version of a new, counterfeit-proof bill for that country. Make your bill the same size as an actual U.S. dollar bill. Use whatever security features you think are important to prevent counterfeiting, and add whatever portraits or symbols you think would best represent your chosen nation.

Part II

Do this part in your group.

Procedure

1. Now that you have drawn your bill, cut it out and test it against same-sized cutouts of wood pulp paper and lightweight cotton cloth, as well as an actual U.S. dollar bill. Once you have done the tests listed in the table, think up some tests of your own to determine how different materials withstand the wear and tear a bill goes through during its lifetime.

Questions

1. What other "invisible" security measures could be added to your bill?
2. How are the materials you tested similar? How are they different?
3. Which sample is most like an actual U.S. bill? How?
4. Why does the material used for the U.S. bill seem like a good choice? Why might the Treasury Department not have chosen the other materials?

		observation			
test	reason for test	your bill	cutout of wood pulp paper	cutout of light-weight cotton cloth	actual U.S. bill
look at each under a microscope or hand lens	to check for features within the material				
place a neodymium magnet near each	to check for magnetic ink				
place each under an ultraviolet light*	to detect which materials will fluoresce				
your test:					
your test:					

Make a chart like this one for your answers

*Wear safety glasses for this test.

Materials for your group

- sheet of white paper
- scissors
- wood pulp paper
- lightweight cotton cloth
- $1 bill
- pencils, crayons or markers
- chalk, highlighters, fluorescent paint
- safety glasses
- microscope or hand lens
- neodymium magnet
- ultraviolet light

© 1999 WGBH Educational Foundation

Activity Answer

Part I

In addition to designing bills for nations, students might also design bills for schools, teams or planets.

Part II

Explanations for test results:

Microscope: Tiny red and blue fibers embedded in U.S. bills can be seen through a microscope or hand lens. Microprinting can be seen around the bill's portrait and in the numerals in the lower left corner.

Magnet: The ink on U.S. paper money contains a magnetic signature; a bill will be drawn toward an especially strong magnet (such as a neodymium magnet).

Ultraviolet light: The bleach in most wood pulp paper will cause the paper to fluoresce; cotton and linen rag paper, used in U.S. bills, will not. Chalk, fluorescent paint, and highlighters will fluoresce.

Other tests: Students might try folding samples multiple times, putting samples in different liquids for various amounts of time (such as detergent, bleach or salt water) or running samples through a clothes dryer.

Resources

Book

Johnson, David Ralph. *Illegal Tender: Counterfeiting and the Secret Service in Nineteenth-Century America.* Washington: Smithsonian Institute Press, 1995.
Surveys the history of counterfeiting and the Secret Services' attempts to combat it.

Web Sites

NOVA Online — Secrets of Making Money
http://www.pbs.org/nova/moolah/
Find out which parts of the bill have been changed, learn more about the history of money, see if you can identify what's wrong with a counterfeit bill and find links to other money resources.

Smithsonian Institution National Numismatic Collection
http://www.si.edu/nmah/csr/cadnnc.htm
Explores such topics as the history of the $20 U.S. gold coin; Russian coins and medals; the coinage of Spain; and images of Native Americans, women and African Americans on early U.S. bank notes.

U.S. Treasury Department Educational Links
http://www.ustreas.gov/education.html
Learn more about the features found on U.S. paper and metal currency, the history of the Treasury Department and its role in the federal government, and how to enter the U.S. Savings Bond Contest in this site for teachers, parents and students of all ages.

Some U.S. Currency Security Features

Security Thread
A polymer thread has words "USA TWENTY" printed on it and glows red under ultraviolet light.

Portrait
The portrait is enlarged and is more detailed.

Serial Number
An additional letter is added to the serial number.

Watermark
A translucent design embedded in the paper can be seen when the bill is held up to the light.

It is illegal to photocopy a bill at any size other than 75 percent or smaller, and 150 percent or larger.

Microprinting
The microprinted words "THE UNITED STATES OF AMERICA" are hard to replicate because they're so small.

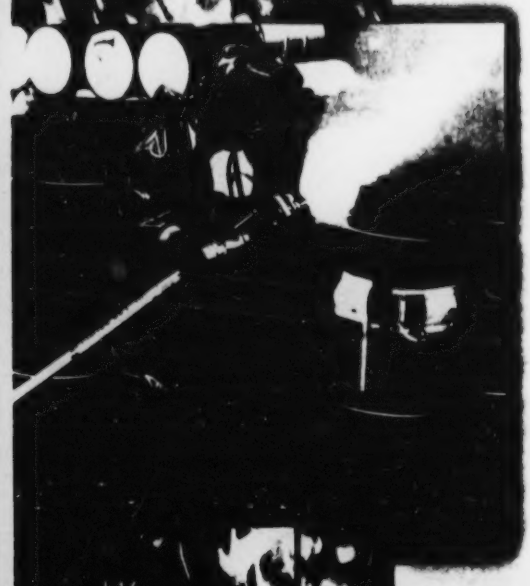
Color-Shifting Ink
The number looks green when viewed straight on but appears black when viewed at an angle.

Program Contents

Note: This program contains graphic images of fires and fire victims. You should preview the program to determine its appropriateness for your classroom.

NOVA investigates fire and the innovative technologies used to prevent and fight it. The program:

- features survivors who describe the 1987 fire at London's King's Cross Station.
- tells about ancient Roman firefighters who invented the pump.
- points out that the Great Fire of London in 1666 led to new building codes and better water systems.
- notes that the pump, forgotten for more than a thousand years, is reinvented by the Dutch.
- looks at other early inventions that improved firefighting including the hose, the hydrant and steam engines.
- looks at today's firefighters, who take advantage of such technology as quick-action water cannons, protective clothing, self-contained breathing apparatus, panic button devices and thermal imaging cameras.
- reviews some of the worst fires in history and examines the lessons learned, including the Triangle Shirtwaist factory fire and Boston's Coconut Grove nightclub fire.
- shows how computer modelling can help predict danger areas, including how people might react during a fire.



A firefighter wears a protective suit outfitted with oxygen tanks to tackle a chemical spill.

Before Watching

1 Find out what students know about fire safety by having them imagine the following: *You are in a packed movie theater when you hear someone yell "Fire!" Smoke begins filling the dark theater and confusion sets in as people struggle to move from their seats. What do you do?* Have students describe how they would get themselves out safely. What problems might they face when trying to exit? What fire safety features would they want to be present in the building?

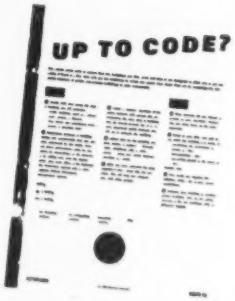
2 Have students create a list of building features that address these three issues: preventing a fire, extinguishing a fire and evacuating a burning building *(such as fire-resistant building materials, fire extinguishers and exit signs)*. As they watch, have students note technologies that help prevent fire, extinguish fire and evacuate people.

After Watching

1 Have students review their lists of fire safety technologies and revise them based on their notes. What are the main features of fire prevention, extinction and evacuation that should be in every building?

Objective

To research and analyze fire safety strategies in public and private buildings.



Materials for each group

- copies of the **Up to Code?** activity sheet on page 16

Procedure

1 Organize students into groups and distribute the **Up to Code?** activity sheet. Explain that each group will collect data on how a building is designed to address three facets of fire safety: preventing a fire from occurring and/or spreading, extinguishing a fire and evacuating people. Groups may choose to investigate a public building (such as a school, mall, cinema or library) or their own home. (If students choose to evaluate their own home, obtain permission first from a parent or guardian.) Students can collect data outside of class over a one- to two-week period.

2 To help students identify types of data to collect, create a class list of elements of building design and construction that address fire safety issues (see **Before Watching #2** and **After Watching #1**). In addition, have students brainstorm a list of places where they could learn about fire safety. (See **Resources** on page 17 for some suggestions.) From their brainstorming and research, have groups create two master checklists of fire safety items (one for public buildings and one for private homes) so that data can be compared later.

3 Have groups gather their information by touring a public building or private home and talking to the person(s) who oversees the property (building manager or parent/guardian).

4 Once they've gathered their information, have students report their findings. From their lists, compile a final checklist on the board for each type of building. Compare the data and discuss similarities and differences between the checklists and the reasons for them.

5 Following their building appraisal, have students generate their own rating system, taking the "least safe" of the buildings they compared and proposing changes to increase its safety.

6 As an **extension,** students could create a "prototype" building that would be as safe as possible. Students should consider cost factors when designing their building.

The activity found on page 16 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard F: Science in Personal and Social Perspectives

Personal health

- The potential for accidents and the existence of hazards imposes the need for injury prevention. Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions. Injury prevention has personal and social dimensions.

Risks and benefits

- Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.
- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes and volcanic eruptions), with chemical hazards (pollutants in air, water, soil and food), with biological hazards (pollen, viruses, bacterial and parasites), social hazards (occupational safety and transportation) and with personal hazards (smoking, dieting, and drinking).

Grades 9–12

Science Standard F: Science in Personal and Social Perspectives

Personal and community health

- Hazards and the potential for accidents exists. Regardless of the environment, the possibility of injury, illness, disability or death may be present. Humans have a variety of mechanisms — sensory, motor, emotional, social and technological — that can reduce and modify hazards.

UP TO CODE?

Fire safety codes exist to ensure that the buildings you live, work and play in are designed to allow you to get out safely if there is a fire. How safe are the buildings in which you spend your time? Find out by analyzing the fire safety features of public and private buildings in your community.

Procedure

1. Decide with your group the type of building you will evaluate:
   - Public Building (such as a school, mall, cinema or library)
   - Your Home (get permission from a parent or guardian first)
2. Brainstorm features of building design and construction that you consider important for fire safety. Find out about government codes for fire safety by researching on the Internet or by calling your local fire department, your local office of the National Fire Protection Agency and/or your regional Federal Emergency Management Agency.
3. Create a "master" checklist of fire safety features with groups who are evaluating the same type of building. This list should include the 10 to 15 most important safety features you will use to evaluate the building.
4. Collect data for the building you have chosen to inspect — through visits, telephone calls or other means — using your safety features checklist as a guide.
5. After you have collected the data, organize it into a chart like the one below. This will help you compare data with other groups.

Building: _____

Age of Building: _____

Use of Building: _____

Fire Prevention Features	*Fire Extinguishing Features*	*Evacuation Features*	*Other*

Make a chart like this one for your data

Questions

1. What features did you choose to include on your checklist? Explain why you think these are the most important.
2. Based on your data, how safe do you think the building is in terms of:
   - preventing the occurrence or spread of a fire?
   - extinguishing a fire?
   - evacuating people in the event of a fire?

   Explain why.
3. How would you improve the building? Make a list of your recommendations.
4. Compare your building to another group's building. How are the safety features of the two buildings alike or different? Explain.

20

© 1999 WGBH Educational Foundation

Activity Answer

As an alternative to having students collect data on a building, invite an architect to present a building plan and explain fire safety features or talk about aspects of your local building code that deal with fire safety. Students can use their checklists to evaluate the building plan.

As students create their checklists, they might consider the following questions:

- What fire safety features are evident in the building? (Note: You might want to point out that some features, such as fire walls, may not be readily apparent.)
- How many smoke detectors, fire alarms, fire extinguishers and fire sprinklers are there? Where are they located?
- How many escape routes are there and are they free of any obstructions? Are the escape routes clearly marked?
- Does the building contain any flammable debris?

When comparing buildings, students might ask themselves:

- Do safety features differ between the two buildings? If so, why might that be?
- How old are the buildings?
- Is one building made of more flammable material than the other?
- What's the appropriate level of risk for a building? What are some factors to consider in evaluating that risk?
- Can a building be made 100 percent fireproof?

Resources

Organizations

National Fire Protection Association (NFPA)

The NFPA publishes a catalog of fire safety products, including a fire facts newsletter, a home inspection list, books to help children learn fire safety behaviors and more. For a catalog of educational materials, call (800) 344-3555.

Web Sites

NOVA Online — Escape: Fire
http://www.pbs.org/nova/escape/
Delves deeper into the program's content and themes with features such as articles, timelines, interviews, interactive activities, resource links, program transcripts and more.

NFPA Codes and Standards Information
http://www.nfpa.org/standards_info.html
Includes a history of the development of fire codes and an overview of how codes are created and used.

NFPA Fire Safety Information
http://www.nfpa.org/fire_safety.html
Includes a national fire escape survey, seasonal and home fire safety tips and a link to mascot Sparky the Fire Dog, who will answer students' questions.

Princeton Review Online
http://www.review.com/career/find/car_search_show.cfm?id=69
Find out what a day in the life of a firefighter is like, what kind of organizations employ firefighters and more in this career profile of a firefighter.

U.S. Fire Safety Administration National Fire Programs
http://www.usfa.fema.gov/safety/sheets.htm
Provides a series of downloadable fact sheets about such topics as the nature of fire, electrical fire prevention, teaching children fire safety, rural fire safety and prevention and more.

Below are basic safety features recommended and/or required by the government for homes and public buildings:

Some Safety Features for Homes*

- smoke detectors — on every level, outside all sleeping areas, tested regularly
- planned escape routes
- fire screens around working fireplaces
- electricity — frayed wires discarded, one electrical item per outlet, appliances in good condition
- combustibles (such as trash, rags, paper) stored away from heat-producing equipment
- matches and lighters stored out of children's reach
- flammable liquids (such as turpentine, barbecue lighter fluid) stored in tightly closed and labeled containers
- portable heating equipment properly maintained and located at least three feet from walls, furniture and other combustibles
- automatic sprinkler system

Some Safety Features for High-Rises*

- smoke and fire alarm system
- automatic sprinkler system
- emergency lighting
- emergency exits
- fire lanes around perimeter of building

*Adapted from materials produced by the National Fire Protection Association.

ESCAPE!: Car Crash

Airs the week of February 16, 1999

Program Contents

Note: This program contains graphic images of car accidents. You should preview the program to determine its appropriateness for your classroom.

NOVA investigates the innovations of scientists and engineers as they work to design safer cars. The program:

- relates the invention of shatterproof and safety glass.
- outlines "crash science," which involves understanding the forces that injure the body — in every accident two collisions occur: when the car collides with an object and when the passenger collides with the interior of the car.
- notes the development of the single most effective safety device in any vehicle — the three-point seat belt.
- follows the introduction of crumple zones and a very rigid passenger cell to reduce injuries.
- follows the development of the air bag, invented in 1952 and now being redesigned to address deployment challenges.
- reviews new technologies under development, such as smart cars and automated highways.

Innovations in car safety design have helped make accidents like this one survivable.

Before Watching

1 According to the National Highway Traffic Safety Administration, traffic injuries are the leading cause of death for people ages 6 to 27. Have students brainstorm a list of traffic laws and car design features that address safety issues *(such as speed limits, drunk driving laws, seat belts and childproof locks)*. As they watch, have students take notes on car safety features.

After Watching

1 On the chalkboard, compile a list of safety features from students' notes. For each feature, discuss what safety issues it addresses, how it evolved and how it works. Is it possible to design a car that is 100 percent safe?

2 Some states have enacted laws requiring people to use seat belts. What role do students think government agencies should play in mandating safety guidelines? As students discuss their opinions, they might consider who is affected by an automobile accident, who bears the cost and how the right to make personal choices about behavior intersects with government's responsibility to legislate behavior in order to protect society.

BEST COPY AVAILABLE

Activity Setup

Objective

To design and implement a study of local seat belt use and compare the results to national statistics.

Materials for each group

- copies of the **Buckled Up?** activity sheets on pages 20–22

Procedure

1 Begin with a discussion about seat belt use. Ask students if they use seat belts, how often and why or why not. What purposes do seat belts serve? What are the benefits and risks of using seat belts?

2 In **Part I,** students will analyze national statistics on seat belt use. Introduce the idea that most states have laws requiring the use of seat belts, and explain the difference between primary and secondary enforcement laws (see **Seat Belt Laws** on page 20). Before students begin, ask what percentage of people in their area they think use seat belts. Organize students into groups and distribute the **Buckled Up?** activity sheets. Have students use the information found in the **National Statistics** chart on page 22 to create a bar graph that represents the data. Then have them analyze their graphs and discuss any patterns they notice.

3 In **Part II,** students will collect and analyze data for seat belt use in their community. As a class, design a data collection strategy and a chart in which to record observations. (You might want to present an actual strategy from **Data Collection Strategies** on page 22.) Assign students to groups again. Have each group identify a **SAFE*** location from which to observe seat belt use.

4 After they've collected data, have groups pool their data and calculate and graph the percentage of drivers and passengers who use seat belts. Compare their local data to national data. To conclude, have students consider any questions that have arisen from their research and how they might answer them.

*** IMPORTANT: Caution students to choose a safe location from which to observe passing motorists and to position themselves at a safe distance from the street. Tell them to avoid busy intersections, multilane roads and highways.**

Standards Connection

The activity found on pages 20–22 aligns with the following **National Science Education Standards** and **Curriculum and Evaluation Standards for School Mathematics.**

Grades 5–8

Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

Mathematics Standard 10: Statistics

Grades 9–12

Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise scientific explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

Mathematics Standard 10: Statistics

Buckled Up? National Data

According to the National Highway Traffic Safety Administration, seat belts are the most effective way to reduce the risk of death and serious injury in automobile accidents. Yet, even with many state laws requiring people to "buckle up," not everyone does. Do you wear your seat belt? What about your friends or family? Conduct a survey to find out how seat belt use across the nation compares to seat belt use in your local area.

Part I *Write your answers on a separate sheet of paper.*

Procedure

1. What percentage of people in your state do you think use seat belts?
2. States have different laws requiring seat belt use. How might the rate of use in a state with a primary law compare to the rate of use in a state with a secondary law? Why?
3. Using the national statistics provided, create a bar graph to represent seat belt usage rates by state. Put the usage rate along the vertical axis and the state name along the horizontal axis. Use different colors to represent the different laws.

Questions

1. What patterns do you notice between usage rate and type of law?
2. Do you find any states that do not fit the general pattern? How might you explain these deviations?
3. In addition to seat belt laws, what other factors might make drivers and passengers buckle up?
4. In addition to a bar graph, what other ways can you represent the data to analyze it?

TRAFFIC

Seat Belt Laws

Under a **primary law**, police officers may stop a vehicle and write citations whenever they observe violations of the seat belt law. Under a **secondary law**, police officers are permitted to write a citation only after the vehicle is stopped for another traffic violation, such as speeding or running a red light.

(Source: NHTSA Traffic Safety Facts 1997 — Occupant Protection)

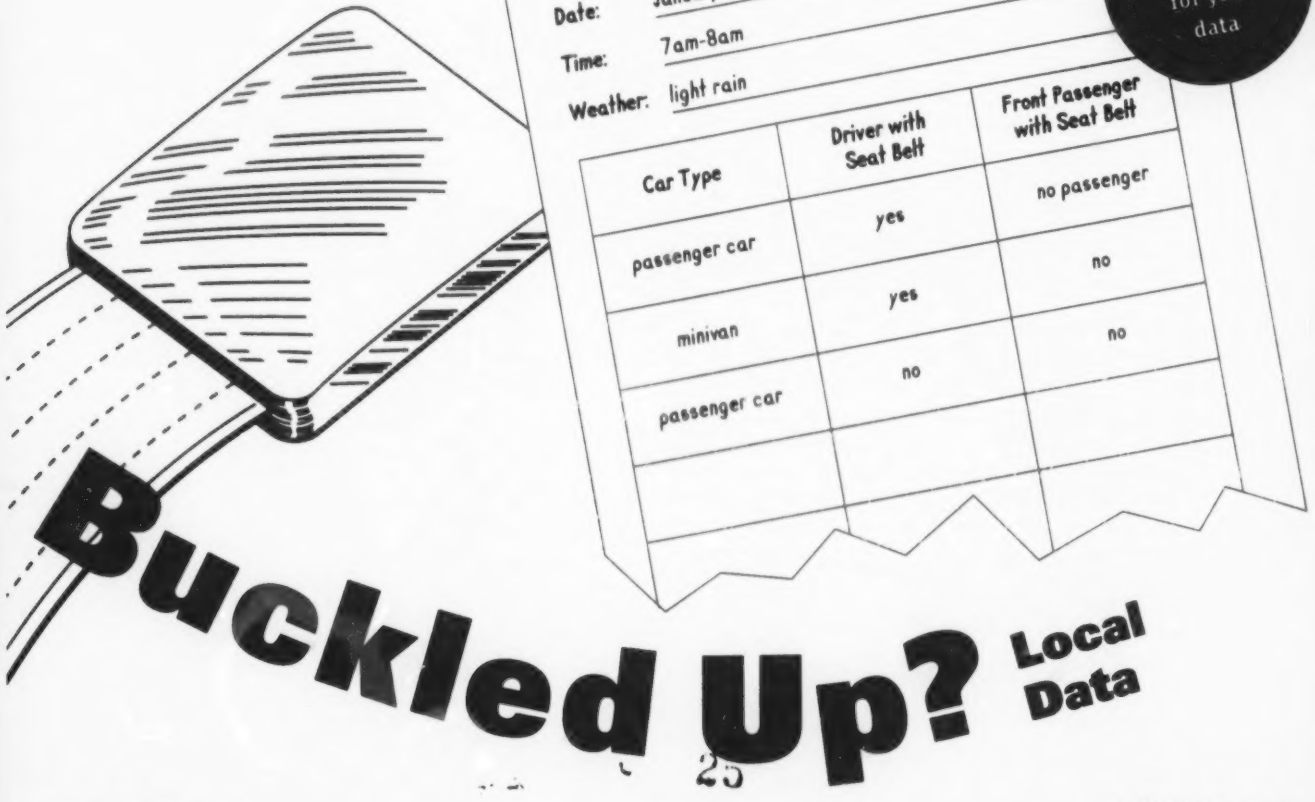
CITATION

© 1999 WGBH Educational Foundation

Part II

Procedure

1. Prepare to collect data on seat belt use in your area to compare to national data. Questions to consider:
   - What is your state's seat belt law?
   - What types of data are you going to collect?
   - Where will you collect your data? **IMPORTANT: Choose a safe location and observe at a safe distance from the street. Avoid busy intersections, multilane roads and highways.**
   - How will you collect your data?
   - How will you record your data?
2. Collect and record your data on a separate sheet of paper. Be sure to include the date, time and location of observation.
3. Combine your data with the class and graph by "number of vehicles" and "occupant seat belt use." (See **Sample Local Data Graph** on page 22.)
4. Interpret the data.
   - How do you interpret the data? What evidence supports your interpretation?
   - List any alternative explanations to how you might interpret the data.
   - What trends do you see, if any?
   - Is your data accurate? Discuss the degree of uncertainty.
5. Compare the class's local data to national data.
   - What are the similarities?
   - What are the differences? How might you explain those differences?
   - How does your data compare to your response to the first question in **Part I?**


Seat Belt Observations
Location: Stop light at the intersection of Elm and Center Streets
Date: January 3
Time: 7am-8am
Weather: light rain
Car Type | Driver with Seat Belt | Front Passenger with Seat Belt
passenger car | yes | no passenger
minivan | yes | no
passenger car | no | no
Make a chart like this one for your data

Buckled Up? Local Data

© 1999 WGBH Educational Foundation

National Statistics: State Seat Belt Laws and Usage Rates

State	Enforcement	Usage Rate (%)*
Alabama	Secondary	52
Alaska	Secondary	69
Arizona	Secondary	63
Arkansas	Secondary	48
California	Primary	88
Colorado	Secondary	59
Connecticut	Primary	64
Delaware	Secondary	60
District of Columbia	Primary	66
Florida	Secondary	60
Georgia	Primary	68
Hawaii	Primary	80
Idaho	Secondary	54
Illinois	Secondary	64
Indiana	Primary	63
Iowa	Primary	75
Kansas	Secondary	56
Kentucky	Secondary	54
Louisiana	Primary	67
Maine	Secondary	61
Maryland	Primary	71
Massachusetts	Secondary	53
Michigan	Secondary	70
Minnesota	Secondary	65
Mississippi	Secondary	48
Missouri	Secondary	62
Montana	Secondary	73
Nebraska	Secondary	63
Nevada	Secondary	70
New Hampshire	no law	58
New Jersey	Secondary	62
New Mexico	Primary	87
New York	Primary	74
North Carolina	Primary	83
North Dakota	Secondary	49
Ohio	Secondary	65
Oklahoma	Primary	60
Oregon	Primary	85
Pennsylvania	Secondary	65
Rhode Island	Secondary	58
South Carolina	Secondary	61
South Dakota	Secondary	59
Tennessee	Secondary	61
Texas	Primary	75
Utah	Secondary	63
Vermont	Secondary	71
Virginia	Secondary	67
Washington	Secondary	82
West Virginia	Secondary	58
Wisconsin	Secondary	62
Wyoming	Secondary	75
Puerto Rico	Primary	67

*Reported as of February 1998
(Source: National Highway Traffic Safety Administration)

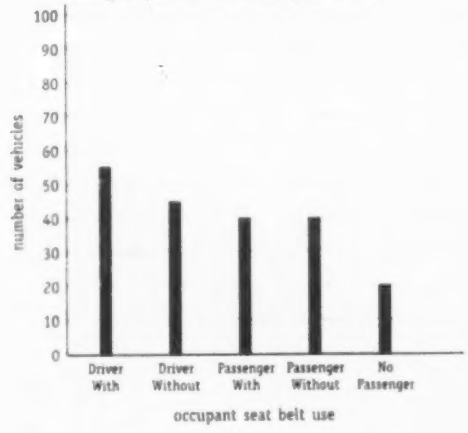
Data Collection Strategies

Statewide surveys vary in methodology and frequency of observation. However, all except Wyoming are based upon direct observation of safety belt use. (Wyoming's data are based upon accident reports.) Because the surveys are generally based on a large number of observations from representative sites, they provide a reasonable estimate of seat belt use.

In 1994 NHTSA conducted the National Occupant Protection Use Survey. For the moving traffic study, which provides information on overall shoulder belt use, pairs of observers were stationed for 30 minutes at exit ramps, intersections with stop signs or stop lights and uncontrolled intersections. One observer counted belt use for the drivers of passenger cars and light trucks (vans, minivans, sport utility vehicles and pickup trucks). The second observer counted belt use for the right front passengers. Every day of the week and all daylight hours were covered by the study. Approximately 4,000 locations were selected and a total of more than 167,000 passenger cars and almost 84,000 light trucks were observed.

(Source: Third Report to Congress on the Effectiveness of Occupant Protection Systems and Their Use — NHTSA, December 1996.)

Sample Local Data Graph (n=100)



© 1999 WGBH Educational Foundation

Activity Answer

In **Part I,** students will create bar graphs to analyze seat belt usage rates by state and law type. As students create their graphs, encourage them to label each axis and to give their graphs a title. Suggest they use as large a scale as possible for the vertical axis to highlight differences in seat belt usage rates between the states.

As of December 1997, 49 states and the District of Columbia had seat belt use laws in effect (New Hampshire has no law). Thirteen enforce primary laws, while 36 enforce secondary laws. In 1997, the average observed belt usage rate reported by states with secondary enforcement was 62 percent, compared to 79 percent in states with primary enforcement.* Students should notice that states with primary enforcement tend to have higher usage rates, although not necessarily. Factors other than type of law can affect a state's seat belt usage rate. These might include how strictly the law is enforced, awareness campaigns for seat belt use, driving conditions (for example, bad weather or dangerous roads might encourage use) and traffic volume (for example, people might be more inclined to use them on congested city roads than on less-traveled, rural roads.)

In **Part II,** students choose a location and design a plan for observing and recording seat belt use. Encourage students to include in their data a description of the location, the date and the time of observation. Students might also want to expand their data collection to include car type and the gender and approximate age of the passengers. You might want to share with students strategies used in actual state surveys (see **Data Collection Strategies** on page 22). Students' results might differ from statewide surveys for a number of reasons, including:

- local data is more easily skewed because the local sample size is smaller than the statewide sample size (for example, five unbelted drivers in a sample of 100 represents 5 percent, while five unbelted drivers in a sample of 100,000 represents .00005 percent).
- local observation may not be representative of the entire state, while statewide observation is more likely to include a cross section of neighborhoods, traffic conditions, differences in law enforcement and so on.
- the time of day and year the survey takes place could affect results (for example, winter conditions might encourage more seat belt use than summer conditions).

(*Source: NHTSA Traffic Safety Facts 1997 — Occupant Protection)

Resources

Organization

National Highway Traffic Safety Administration

Call or write to your local office for data on current seat belt usage rates and other topics. Regional contact information is listed in the telephone book or on the Web at: http://www.nhtsa.dot.gov/nhtsa/whatis/regions/

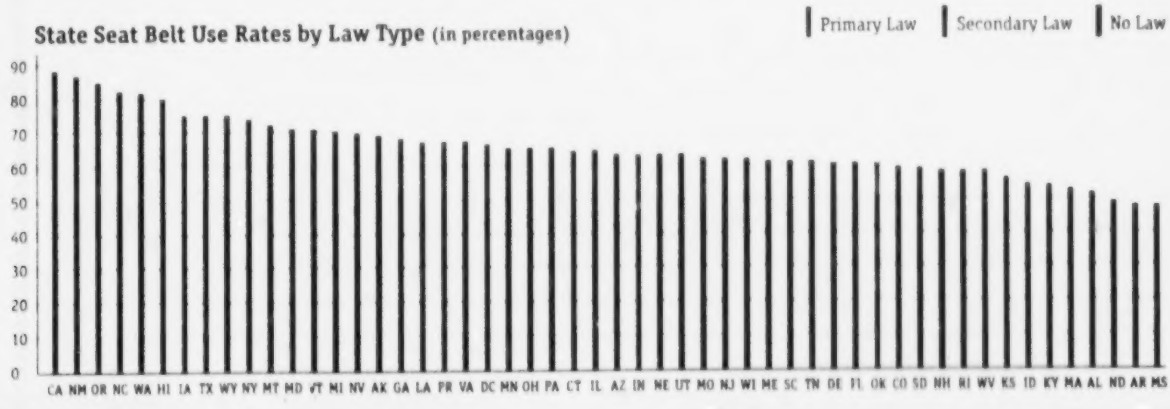
Web Sites

NOVA Online — Escape: Car Crash
http://www.pbs.org/nova/escape/
Delves deeper into the program's content and themes with features such as articles, timelines, interviews, activities, resource links and program transcripts.

Buckle Up: Presidential Initiative for Increasing Seat Belt Use Nationwide
http://www.nhtsa.dot.gov/people/injury/airbags/presbelt/
Contains statistics on national seat belt usage rates and outlines the national strategy for increasing seat belt use.

Traffic Safety Facts 1997
http://www.nhtsa.dot.gov/people/ncsa/factshet.html
These NHTSA fact sheets include information on occupant protection and traffic safety.

State Seat Belt Use Rates by Law Type (in percentages)


Primary Law
Secondary Law
No Law
90
80
70
60
50
40
30
20
10
0
CA NM OR NC WA HI IA TX WY NY MT MD VT MI NV AK GA LA PR VA DC MN OH PA CT IL AZ IN NE UT MO NJ WI ME SC TN DE FL OK CO SD NH RI WV KS ID KY MA AL ND AR MS

(Source: National Highway Traffic Safety Administration)

Airs the week of March 30, 1999

Volcanoes of the Deep

Program Contents

NOVA follows a team of scientists as they journey to the Juan de Fuca Ridge in the Pacific Ocean to study and raise hydrothermal vent structures from the ocean floor. The program:

- shows how JASON — a small robot with video cameras, sonar imaging tools and lights — collects data about the smokers. Engineers use three-dimensional images generated from the data to design equipment that will capture, cut and haul four of the structures.
- reviews the process by which "black smoker chimneys" — chimneylike structures around hydrothermal vents — form.
- explains how biologists study organisms that live on and near the smokers, and speculates about clues the organisms might hold regarding how life originated on Earth.
- details the recovery plan and successful raising of the four chimneys to the surface.

Extreme conditions exist at hydrothermal vents located 2,286 meters (7,500 feet) below the ocean surface, including complete darkness, pressure of nearly 1,520 kilograms (3,350 pounds) per square inch, and temperatures ranging from 2°C (35°F) to 350°C (662°F).

Before Watching

1 On a map of the floor of the Pacific Ocean, have students locate the Juan de Fuca Ridge. Review with students how the Earth's crust is made of tectonic plates that move, and how seafloor spreading and subduction occur.

2 Have students discuss extreme environments, such as a desert, Antarctica or the top of Mount Everest. What makes these environments extreme? What kinds of organisms live there? How have they adapted in order to survive? Have students brainstorm a list of conditions they think would be found at the Juan de Fuca Ridge. As they watch, have students look for organisms and the adaptations that enable them to live in such harsh conditions.

After Watching

1 Review with students their lists of organisms found deep below the ocean surface and some of the adaptations of each organism that enable it to survive there. What adaptations are common among the organisms? What adaptations are unique to a particular organism?

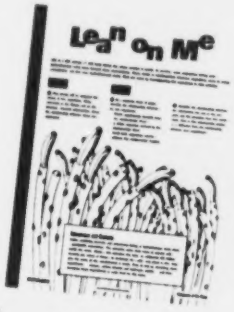
Activity Setup

Objective

To research and classify symbiotic relationships between individual organisms of different species.

Materials for each group

- copies of the **Lean on Me** activity sheet on page 26
- access to resources from the Internet or library



Procedure

1 Begin with a class discussion about the ways in which individual organisms — and groups of organisms — interact with each other. Introduce or review symbiosis as a relationship in which two organisms of different species have a close association.

2 Organize students into pairs or groups and distribute the **Lean on Me** activity sheet. Assign one pair of organisms from the **Close Ties** list below to each group. Have students research information about the relationship between their assigned organisms.

3 Once students complete their research, have each group present its findings. Ask the class to identify the similarities and differences among the organisms' associations. Create a chart with column headings for different types of relationship — such as mutualism, commensalism and parasitism — and have students place their pair of organisms in the appropriate column. Have students use their research to support their classification.

4 To conclude, ask students to consider the relationship between sulfur-oxidizing bacteria and tubeworms at hydrothermal vents. How would they classify this interaction? What other symbiotic relationships did they observe between organisms living near hydrothermal vents?

5 As an **extension,** have students determine where in the food web their pair of organisms fits. Discuss what the effects on the entire ecosystem might be if one or both of the organisms no longer existed.

Close Ties

- shrimp and sea anemone
- green alga and fungus (lichen)
- rhizobium bacteria and soybean plant
- hermit crab and sea anemone
- oxpecker bird and hippopotamus
- tapeworm and dog
- crocodile and Egyptian plover
- ant and acacia tree
- cleaner fish and shark
- tick and cow

29

Standards Connection

The activity found on page 26 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard C: Life Science

Populations and ecosystems

- Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers — they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers and decomposers in an ecosystem.

Grades 9–12

Science Standard C: Life Science

The interdependence of organisms

- Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.

Lean on Me

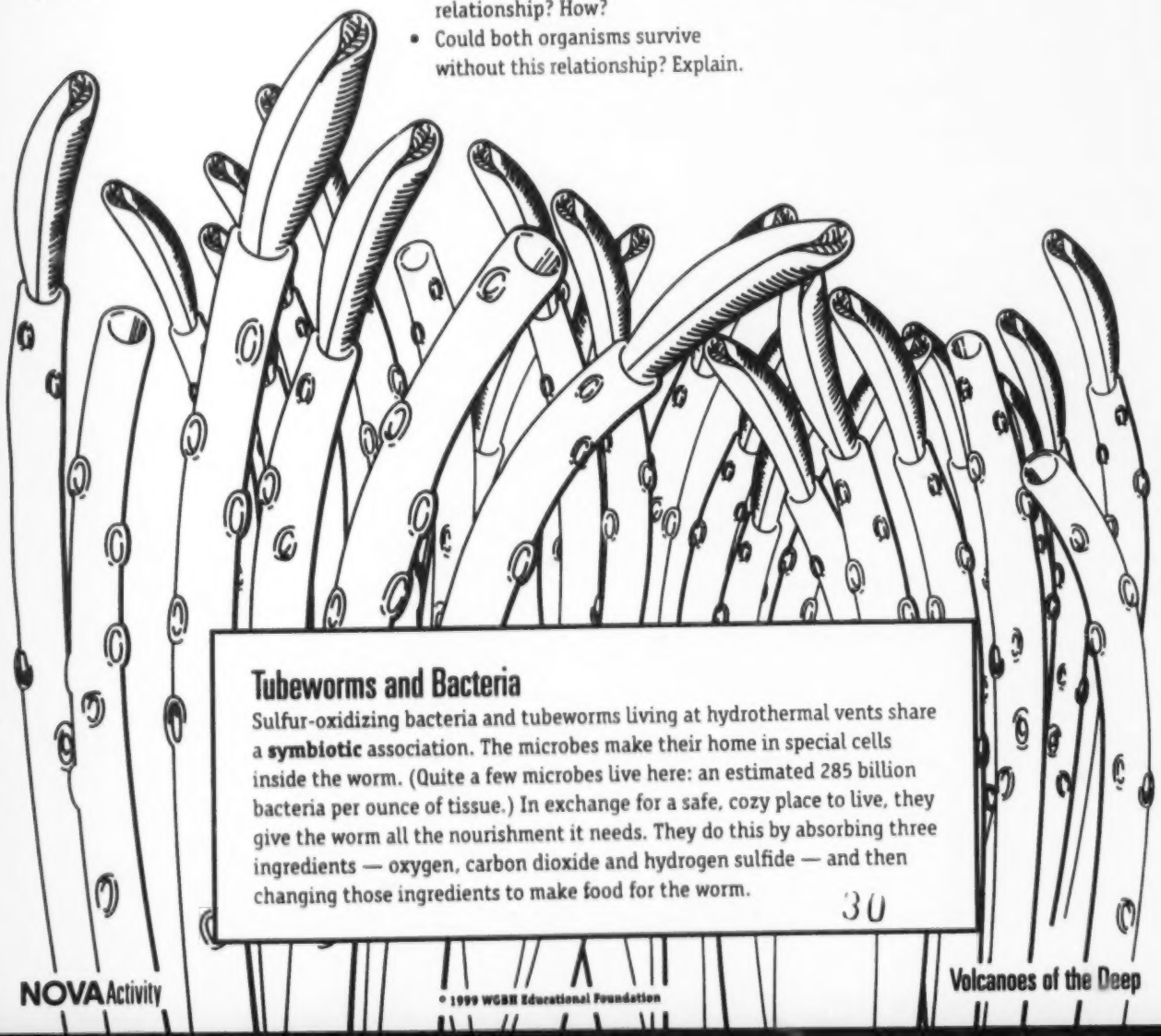
Life at 2,286 meters (7,500 feet) below the ocean surface is harsh. To survive, some organisms living near hydrothermal vents have formed close associations. These kinds of relationships between organisms occur in many ecosystems, not just near hydrothermal vents. Find out more by investigating the organisms in this activity.

Procedure

1. Your group will be assigned the names of two organisms. Using resources in the library and on the Internet, research information about the relationship between these two organisms.

Questions

1. On a separate sheet of paper, describe the relationship between the two organisms.
   - Which organism(s) benefits from the relationship? How?
   - Is either organism harmed by the relationship? How?
   - Could both organisms survive without this relationship? Explain.
2. Consider the relationship between the tubeworms you saw in the program and the microbes that live inside them. How is this relationship similar to or different from the relationship between your organisms?



Tubeworms and Bacteria

Sulfur-oxidizing bacteria and tubeworms living at hydrothermal vents share a **symbiotic** association. The microbes make their home in special cells inside the worm. (Quite a few microbes live here: an estimated 285 billion bacteria per ounce of tissue.) In exchange for a safe, cozy place to live, they give the worm all the nourishment it needs. They do this by absorbing three ingredients — oxygen, carbon dioxide and hydrogen sulfide — and then changing those ingredients to make food for the worm.

30

© 1999 WGBH Educational Foundation

Activity Answer

Symbiosis is defined as a close association between two organisms of different species. If one organism benefits and the other neither benefits nor is harmed, the interaction is called commensalism. If both organisms benefit, the interaction is called mutualism. If one organism is harmed and the other benefits, the interaction is called parasitism. Some relationships may be more than one kind.

Often the distinction between mutualistic and commensal relationships is not clear. Very close associations in which both organisms depend on each other for survival are mutualistic. Looser associations can be defined as either mutualistic or commensal. Students' research may differ from the chart below.

Some students may wonder how the predator and prey relationship is different from parasitism. Like predators, parasites take sustenance from another living organism. However, because a parasite's survival also depends on the survival of its host, it does not kill the host outright. A parasite lives on or in the host for some part of its life cycle, and the host may or may not die as a result of the association.

Organisms	Type of Symbiotic Relationship	Description of Relationship
shrimp and sea anemone	commensalism	The shrimp is immune to the stinging tentacles of the sea anemone. By hiding in the sea anemone, the shrimp is protected from predators.
green alga and fungus (lichen)	mutualism	A green alga and fungus are dependent on each other. The fungus gains nutrients synthesized from the alga, and the alga receives water and nutrient salts from the fungus.
rhizobium bacteria and soybean plant	mutualism	The bacteria found on the roots of a soybean plant fix atmospheric nitrogen and make it available to the plant. The bacteria receives carbohydrates from the plant.
hermit crab and sea anemone	mutualism	The hermit crab is less likely to be eaten by cuttlefish when an anemone rides on its shell. The anemone gains access to a wider feeding range.
oxpecker bird and hippopotamus	commensalism	The oxpecker bird eats ticks living on the hippopotamus's back.
tapeworm and dog	parasitism	The tapeworm attaches to the intestinal wall of the dog and takes nutrients consumed by the dog.
crocodile and Egyptian plover	mutualism	The Egyptian plover feeds on leeches and other scraps of food in the crocodile's mouth. The crocodile benefits because the plover cleans its teeth.
ant and acacia tree	mutualism	The ant burrows into a thorn of the acacia tree to live and eat sugar secreted by the tree. The ants benefit the tree by attacking predators.
cleaner fish and shark	mutualism	The cleaner fish feeds on parasites in the shark's mouth and gills.
tick and cow	parasitism	The tick burrows into the cow's skin to suck blood.

Resources

Book

Van Dover, Cindy Lee. *The Octopus' Garden*. Reading, Mass.: Addison-Wesley, 1996.
The author, a former submersible pilot, describes the difficult conditions under which scientists work as they explore the bottom of the sea.

Article

Tunnicliffe, Verena. "Hydrothermal-Vent Communities of the Deep Sea." *American Scientist* (July/August 1992): 336–349.
Describes communities found near hydrothermal vents including examples of animals that use chemosynthesis as their energy source.

Web Sites

NOVA Online — Into the Abyss
http://www.pbs.org/nova/abyss/
Provides background information on the research expedition featured, life in deep ocean environments, technology used to raise a deep-sea vent, location of global vent sites and a timeline of undersea exploration.

American Museum of Natural History: Black Smokers
http://www.amnhonline.org/expeditions/blacksmokers/home.html
Describes the research expedition. An online activity challenges students to design a plan to raise a black smoker and then compare their solution to the one used by the expedition team.

Revel Project
http://www.ocean.washington.edu/outreach/revel/
This initiative, Research and Education: Volcanoes, Exploration and Life (REVEL), promotes interaction between teachers and scientists. Selected teachers participate in seagoing research expeditions.

Odyssey of Life: The Ultimate Journey

Airs the week of May 18, 1999

Program Contents

NOVA explores the links between our individual development and the evolution of life itself. The program:

- shows how an egg is fertilized and begins to develop, tracing the development of an embryo from three weeks, when it is only 1/16 inch long, to 19 weeks, when all its features are clearly defined.
- compares the beginning stages of development among vertebrates, revealing them to be very similar.
- reviews the primary mechanism of evolution — natural selection — a process in which genetic changes, or mutations, sometimes lead to new features in individuals. This, in turn, could provide an inheritable advantage in the form of improved ability to survive and reproduce.
- explores the process of how life might have developed, from the first self-replicating molecules to complex animals.
- examines how particular features — such as gills, tails and arms — may have evolved.
- outlines the similarity between humans and chimpanzees and gorillas, which share 98 percent of the same genes.

A developing human embryo can closely resemble other four-limbed vertebrate embryos before its features are clearly defined as seen here.

Before Watching

1 Distinguishing fact from theory can prove challenging. It is, for example, a fact that life on Earth has changed over geologic time. There are many theories concerning precisely how life began, by what mechanism or mechanisms life evolves, through what stages evolving life forms may have passed and how quickly evolution takes place. Discuss with students what makes something a fact and what makes it a theory. Have students work in groups to collect resources about evolution. Then have each group create two lists: one enumerating facts about the history of life on Earth, and the other describing theories that attempt to explain those facts. Review students' findings and facilitate a discussion in which they debate and defend their reasoning for why something is a fact or a theory.

After Watching

1 Have students use a piece of string to represent the Earth's geologic history. Have them devise a scale to calculate the length of string they will need to represent the planet's entire geologic history and the length of each geologic period. *(If they use a scale of 1 inch = 10 million years, for example, the string would be 41.7 feet long.)* Then have them measure out the string and mark each period to scale, noting how much string represents the periods that include the evolution of life.

Activity Setup

Objective

To understand that all vertebrate animals begin their development with very similar genetic blueprints.

Materials for each student

- copies of the **Timing Is Everything** activity sheet on page 30

Procedure

1 Copy and distribute the **Timing Is Everything** activity sheet. Have students cut out and reassemble the squares in an order that correctly represents three developmental stages of the five animals depicted (fish, chick, pig, calf and human).

2 When students finish, have them explain the reasoning behind their answers. To conclude, have a discussion about the similarities and differences students see in the embryos. Since these five animals look similar in their early embryonic stages, might all vertebrates look similar in those stages? What might that suggest?

3 As an **extension,** have students research how the theory of evolution has been viewed from the 1800s through today.

Standards Connection

The activity found on page 30 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard C: Life Science

Structure and function in living systems

- Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are, in turn, grouped together to form larger functional units, called organs. Each type of cell, tissue and organ has a distinct structure and set of functions that serve the organism as a whole.

Grades 9–12

Science Standard C: Life Science

The cell

- Cells can differentiate, and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells. In the development of these multicellular organisms, the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism. The differentiation is regulated through the expression of different genes.

Biological evolution

- The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms.
- The millions of different species of plants, animals and microorganisms that live on Earth today are related by descent from common ancestors.

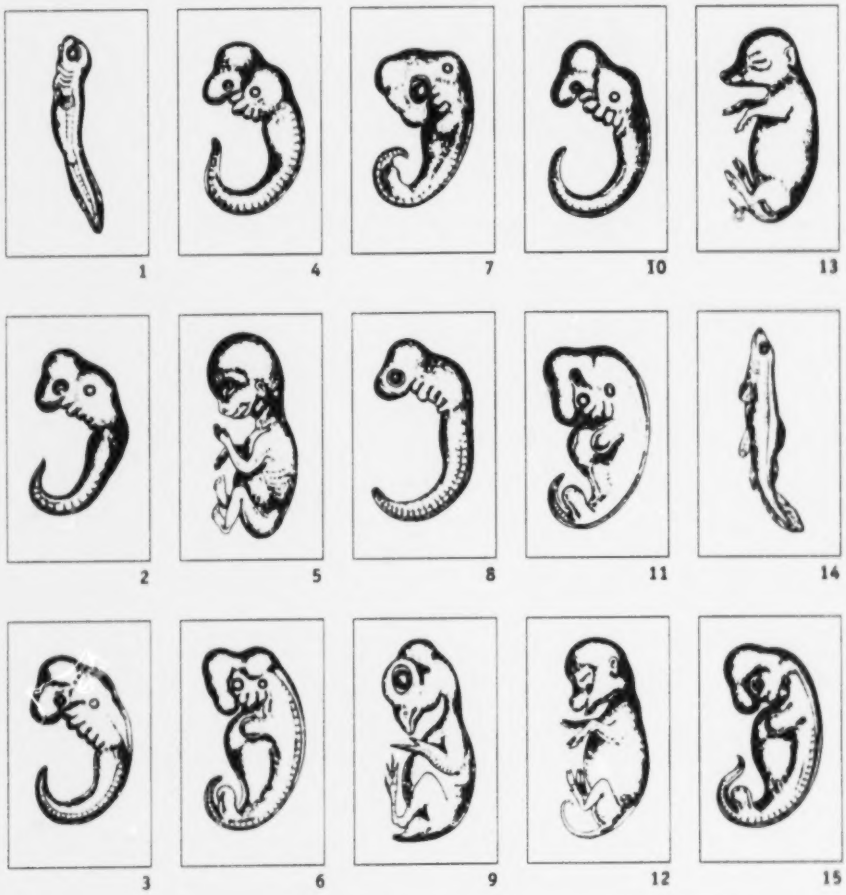
Timing IS Everything

Can you tell a chicken from a fish? How about a human from a pig? Sure you can, you say. Chickens have wings, fish have fins, humans have arms and pigs have hoofs. But what about when they are just starting to form? The drawings below represent three developmental stages of five different animals. They have been all mixed up — see if you can tell what's what.

Procedure

1. Cut out the squares and see if you can correctly match the embryos with the animals, placing them in order from earliest to latest stages of development. Make a chart like the one below to organize the squares.

2. When you are done, write an explanation of why you ordered the drawings the way you did. What are some similarities among the drawings? What are some differences? What, if any, patterns do you see as you go from stage 1 to stage 3?



	fish	chick	pig	calf	human
stage 1					
stage 2					
stage 3					

Make a chart like this one for your answers

© 1999 WGBH Educational Foundation

Activity Answer

stage 1: 8, 2, 4, 10, 3
stage 2: 1, 7, 15, 6, 11
stage 3: 14, 9, 13, 12, 5

Students may think that the embryos only look similar. Point out that the backbones and limbs of all four-limbed vertebrates (also called tetrapods) are identical in embryonic origin and underlying structure. Even though they may differ in final external form and function, the various tetrapod limbs (arms, legs, flippers, wings) are all built from precisely the same sets of embryonic tissues, are supported by the same sets of bones, and are moved by the same sets of muscles. These extensive homologies reinforce the scientific understanding that all tetrapods have descended, with various modifications, from ancient, long-extinct ancestors.

Resources

Book

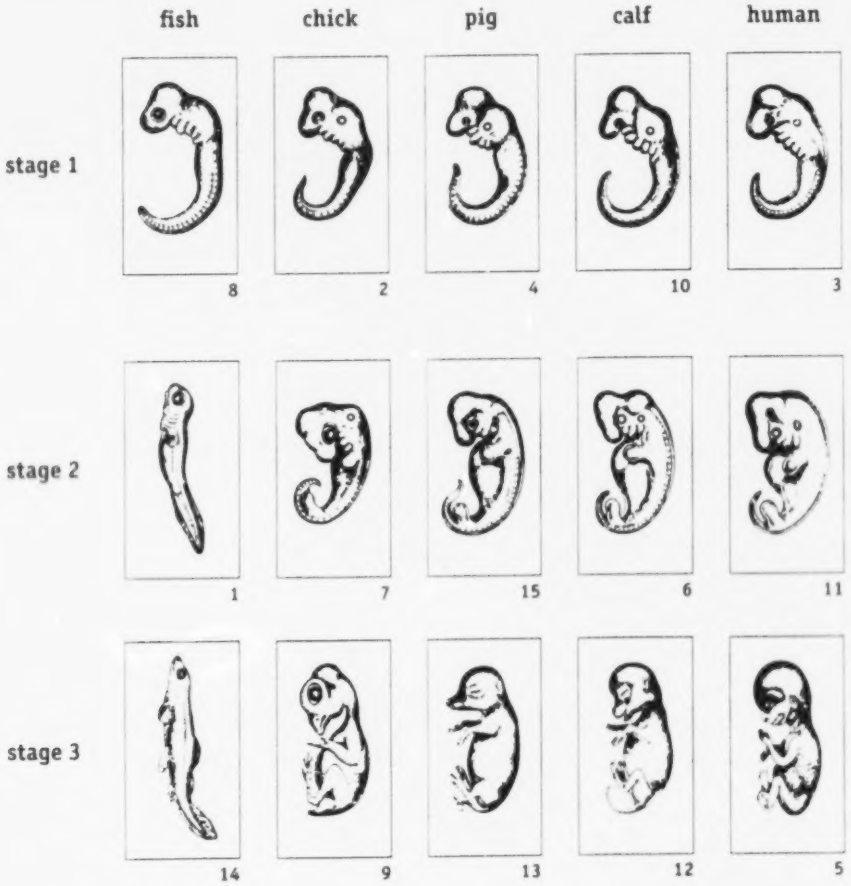
Lewin, Roger. *The Origin of Modern Humans.* New York: Scientific American Library: Distributed by W.H. Freeman, 1993.
Looks at possible preludes to Homo sapiens, various hypotheses regarding the origin of modern humans, the idea of a Mitrochondrial Eve, the archaeology of modern humans and the origin of language.

Web Sites

NOVA Online — Odyssey of Life
http://www.pbs.org/nova/odyssey/
Includes a cyberdebate about how humans evolved; time-lapse sequences of growing human, pig, chicken and fish embryos; an interview with photographer Lennart Nilsson; an essay about the commonalities among species; and an online activity that reveals what bugs live in, on and around us.

Talk Origins
http://www.talkorigins.org/
This newsgroup is devoted to the discussion and debate of biological and physical origins. Most discussions in the newsgroup center on the creation–evolution controversy, but other topics of discussion include the origin of life, geology, biology, cosmology and theology.

The Visible Embryo
http://www.visembryo.com/
Follows human embryological development over 40 weeks, providing in-depth information about what occurs at each stage.



Note:
These illustrations are representations — not exact depictions — of the embryonic stages of each of these five animals.

NOVA Video Catalog

NOVA

Celebrate our 25th anniversary!

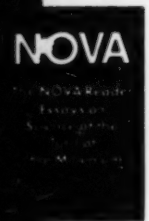
NOVA for $9.95!*
Teachers save 50% off every NOVA video when you order by June 30,1999.

To order, call 1-800-949-8670. Mention "NOVA 25" to receive your 50% off discount!

* Individual videos, not including shipping and handling; this offer good through June 30, 1999.

PBS BOSTON VIDEO

Bonus! 25% off the NOVA 25th anniversary book.



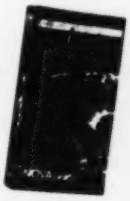
The Nova Reader discusses recent discoveries and possible future directions in particularly active fields of scientific research such as genetics, computer science, environmental science, space exploration and neuroscience.(5"x 7½", hardcover, 352 pages, black & white photos)
WG546 ~~$24.95~~ **$18.50** Available Winter '99.

These videos have been categorized by their primary content strand; many programs are interdisciplinary. You may want to scan several categories for videos of interest.

Earth and Space Science

Adrift on the Gulf Stream
Explore the Stream's importance to ocean life, climate and human history. Writer Bill MacLeish travels its full course, sailing on top of it, under it and viewing its mighty swirl via satellites in space. *Educational use only.* 1 hr. **WG1606*** ~~$19.95~~ **$9.95**

Buried in Ash
Learn what life was like ten million years ago when an enormous volcanic eruption buried much of what is now Nebraska in up to ten feet of ash, preserving countless skeletons of prehistoric big game animals. 1 hr. **WG2117*** ~~$19.95~~ **$9.95**

NEW! Chasing El Niño

The California coast is washed away by violent storms... lethal ice storms invade Canada... Indonesian forests become raging infernos... what in the world is going on here? It's El Niño, the mysterious global weather phenomenon. Watch *NOVA* explore the myths, reveal the devastation and provide a new climate for understanding El Niño. 1 hr. **WG2512** ~~$19.95~~ **$9.95**

Countdown to the Invisible Universe
Infrared telescopes unveil the outer regions of space. 1 hr. **WG1401** ~~$19.95~~ **$9.95**

Cracking the Ice Age
Could the Himalayas be the cause of one of the planet's most dramatic climactic changes—the ice age? Take a trek to Tibet with a renegade band of researchers bent on proving this controversial concept. *Educational use only.* 1 hr. **WG2320*** ~~$19.95~~ **$9.95**

Danger in the Jet Stream
Climb aboard and experience the exhilaration—and the terror—of trying to fly a balloon around the world. 1 hr. **WG2419*** ~~$19.95~~ **$9.95**

NEW! Deadly Shadow of Vesuvius
See why new geological evidence suggests that Mount Vesuvius—infamous for the demise of ancient Pompeii—may pose a new threat to the contemporary city of Pozzouli. 1 hr. **WG2515** ~~$19.95~~ **$9.95**

Dinosaur Hunt Boxed Set

Of all the creatures that ever walked the earth, none captures the human imagination like the dinosaur. See scientists offer important clues to the mystery of the evolution of life. 3-video set includes *Curse of T. rex, Case of the Flying Dinosaur* and *T. rex Exposed*. 3 hrs. **WG737 ~~$29.95~~ $19.95**

- **Curse of T. rex**
  An unusual battle is brewing: Who gets to keep "Sue," a magnificent million-dollar T. rex that turned up on a South Dakota ranch? Everyone wants a piece of her, from the tribal council to the fossil dealers to the scientists. Head out west and join the investigation in this tale of fossil crime and punishment. 1 hr. **WG2408 ~~$19.95~~ $9.95**
- **Case of the Flying Dinosaur**
  Explore the link between dinosaurs and birds, and tune in to the fierce debate—about whether dinosaurs are truly extinct—that continues to captivate no matter how you choose to draw the family tree. 1 hr. **WG1805 ~~$19.95~~ $9.95**
- **T. rex Exposed**
  Go on a suspenseful dig in Montana, where a crew is carefully uncovering one of the most complete Tyrannosaurus rex specimens ever found. 1 hr. **WG1806 ~~$19.95~~ $9.95**

Dinosaurs of the Gobi

NOVA accompanies an American Museum of Natural History expedition to the Gobi Desert. The trip relives the exploits of the Museum's dashing explorer of the 1920s, Roy Chapman Andrews—said to be the real-life model for Indiana Jones. *Educational use only.* 1 hr. **WGW2102* ~~$19.95~~ $9.95**

The Doomsday Asteroid

Join the hunt to scan the skies and earth for evidence that giant rocks from outer space have struck before and will strike again. *Educational use only.* 1 hr. **WGD2212* ~~$19.95~~ $9.95**

NEW! Earthquake

Will the earth send us a warning signal before the next "big one" strikes? Predicting earthquakes is risky business, but *Earthquake* shows how today's advanced technology helps geologists interpret nature's rumblings. 1 hr. **WG1715 ~~$19.95~~ $9.95**

NEW! Everest—The Death Zone

Witness first hand why rational people can make astonishingly poor, and sometimes fatal, decisions on the world's highest peak. Narrated by Jodie Foster. 1 hr. **WG2506 ~~$19.95~~ $9.95**

Flood!

Relive one of the greatest flood disasters—the Mississippi River in the summer of 1993—and explore the problem of taming the mightiest river. 1 hr. **WG2307 ~~$19.95~~ $9.95**

Hawaii Born of Fire

Behold the fiery moonscapes and lush rain forests surrounding Hawaii's active volcanoes. *Educational use only.* 1 hr. **WGH2211 ~~$19.95~~ $9.95**

Hunt for Alien Worlds

All eyes are on the heavens in search of planets around other stars, probably the best hope for showing that we may not be alone in the universe. *NOVA* covers an effort that is turning up more and more new worlds. *Educational use only.* 1 hr. **WG2407* ~~$19.95~~ $9.95**

NEW! Ice Mummies Boxed Set

Witness fascinating accounts of cutting-edge science and archaeology delving into the mysteries of frozen human remains. 3-video set includes *Frozen in Heaven, Siberian Ice Maiden* and *Return of the Iceman*. 3 hrs. **WG2525 ~~$49.95~~ $24.95**

- **Frozen in Heaven**
  This is the bizarre and fascinating story of the remains of Inca culture, frozen for posterity high in the mountains of the Andes. 1 hr. **WG2516 ~~$19.95~~ $9.95**
- **Siberian Ice Maiden**
  Mummified and then frozen by freak climactic conditions 2400 years ago, the Siberian Ice Lady is believed to have been a shamaness of the lost Pazyryk culture. Her body has now been restored, and is providing new clues as to the role and power of women in the nomadic peoples of ancient Siberia. 1 hr. **WG2517 ~~$19.95~~ $9.95**
- **Return of the Iceman**
  Cutting-edge science and archaeology is reconstructing the life and culture of the Iceman—the five thousand year-old frozen corpse found buried in the ice of the Alps. 1 hr. **WG2518 ~~$19.95~~ $9.95**

Iceman

NOVA covers the international efforts to unlock the secrets behind the mummified body of a man who lived over 5000 years ago, discovered in the Alps by two German hikers. *Educational use only.* 1 hr. **WG1916* ~~$19.95~~ $9.95**

In Search of Human Origins Boxed Set

The award-winning exploration of the beginnings and expansion of the human race. 3-video set includes *The Story of Lucy, Surviving in Africa* and *The Creative Revolution*. 3 hrs. **WGW2111 ~~$49.95~~ $24.95**

- **The Story of Lucy**
  Discover the missing link between humans and apes. 1 hr. **WGW2106 ~~$19.95~~ $9.95**
- **Surviving in Africa**
  Witness a living experiment to understand how early humans thrived. 1 hr. **WGW2107 ~~$19.95~~ $9.95**
- **The Creative Revolution**
  Examine the world-wide expansion and evolution of the human race. 1 hr. **WGW2108 ~~$19.95~~ $9.95**

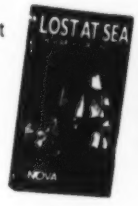
Journey to Kilimanjaro

Travel from an equatorial blizzard on Mount Kenya to the majestic crown of the mighty Kilimanjaro. *Educational use only.* 1 hr. **WGW2104* ~~$19.95~~ $9.95**

Journey to the Sacred Sea

Travel to Lake Baikal, the world's oldest and deepest lake. Watch *NOVA* chart its dramatically changing environment over the course of four seasons. *Educational use only.* 1 hr. **WG2119* ~~$19.95~~ $9.95**

NEW! Lost at Sea: The Search for Longitude



One of humankind's most epic quests—navigation beyond the sight of land—is celebrated in the story of John Harrison, an English clock-maker. Join an adventurous expedition demonstrating the life and death importance of finding longitude at sea. 1 hr. **WG2511 ~~$19.95~~ $9.95**

Lost City of Arabia

The secrets of Ubar, ancient city of mystery from the Arabian Nights which vanished in the shifting desert sands, are revealed as archaeology and space-age intelligence team up. *Educational Use Only.* 1 hr. **WG2312* ~~$19.95~~ $9.95**

Mammoths of the Ice Age

Watch scientists piece together a picture of the life our ancestors shared with the woolly mammoth. *Educational use only.* 1 hr. **WGZ201* ~~$19.95~~ $9.95**

NEW! Mysterious Mummies of China

Perfectly preserved 3000-year-old mummies have been unearthed in a remote Chinese desert, but they have long, blonde hair and blue eyes. New evidence of the lost civilization of the Tocharians along the Silk Road offers more clues to this mystery from the past. 1 hr. **WG2502 ~~$19.95~~ $9.95**

CC NOVA videos are closed-captioned for the hearing impaired
* no retail packaging

1-800-949-8670 To order, call and mention "NOVA 25"

33

The Mystery of Space Set

Travel into space to uncover the mysteries and wonders of our galaxy. 3-video set includes *Death of a Star, Eclipse of the Century* and *Rescue Mission in Space*. 3 hrs. **WG162 ~~$49.85~~ $24.95**

- **Death of a Star**
  Witness one of the most spectacular events since creation—the supernova. 1 hr. **WG1411 ~~$19.95~~ $9.95**
- **Eclipse of the Century**
  The race to view and study celestial splendor. 1 hr. **WG1910 ~~$19.95~~ $9.95**
- **Rescue Mission in Space**
  Witness the dramatic space repair of the Hubble Telescope and view the stunning images of space that it now produces. 1 hr. **WG2118 ~~$19.95~~ $9.95**

SAVE 50% on orders received by 6/30/99

Natural Disasters Boxed Set

Natural disasters strike with little or no warning—making them uniquely frightening and fascinating. Still, scientists continue to search for ways to guard us against nature's fury. 3-video set includes *The Day the Earth Shook, Tornado!*, and *In the Path of a Killer Volcano*. 3 hrs. **WG165 ~~$49.85~~ $24.95**

- **The Day the Earth Shook**
  Does a devastating earthquake lurk beneath Los Angeles? Have we learned any lessons from the past? Watch terrifying scenes from Kobe, Japan, and Northridge, California—and find out how new warning and rescue technology could protect us if it's put into place in time. 1 hr. **WG2302 ~~$19.95~~ $9.95**
- **Tornado!**
  Travel with "stormchasers" as they view the awesome power of tornadoes sweeping across the land and seek to understand how they are created. 1 hr. **WG1217 ~~$19.95~~ $9.95**
- **In the Path of a Killer Volcano**
  The Philippines' Mount Pinatubo is about to blow big. Is there enough time to evacuate the hundreds of thousands in its raging path? Stay with the scientists who remain behind—and see some astonishing footage of the world's largest volcanic eruption in 80 years. 1 hr. **WG2005 ~~$19.95~~ $9.95**

Nature's Fury Boxed Set

Witness the awesome power of nature and then travel with the "stormchasers" into danger in an effort to better understand and predict these extraordinary cataclysms. 3-video set includes *Hurricane!, Lightning!* and *Killer Quake!*. 3 hrs. **WG027 ~~$49.85~~ $24.95**

- **Hurricane!**
  Witness nature's fury as hurricanes Camille and Gilbert crash onto the Gulf coast. 1 hr. **WG1616 ~~$19.95~~ $9.95**
- **Lightning!**
  Join an adventurous investigation into the source of lightning, nature's most dazzling and dangerous display, and take a front seat for nature's electrifying light show set to music. 1 hr. **WGA2213 ~~$19.95~~ $9.95**
- **Killer Quake!**
  Relive the L.A. earthquake, and preview what it portends for California's future.... 1 hr. **WG2116 ~~$19.95~~ $9.95**

Nomads of the Rainforest

Visit the unique tribe of the Waironi Indians in eastern Ecuador. 1 hr. **WG1112 ~~$19.95~~ $9.95**

NEW! Search for the Lost Cave People

Discover a lost civilization that inhabited caves high on the isolated cliffs of Southern Mexico nearly 1000 years ago. The tantalizing clues, including graphic evidence of ritual child sacrifice and a sophisticated writing system, shed new light on this mysterious people, the Zoqui, who may have been precursors of the Mayans. 1 hr. **WG2507 ~~$19.95~~ $9.95**

NEW! Terror in Space

Witness the harrowing and life-threatening problems aboard the aging Mir space station through the eyes of the Russian and American astronauts who lived through them. 1 hr. **WG2513* ~~$19.95~~ $9.95**

Three Men and a Balloon

For a few diehard daredevils, it's "the last great challenge in aviation" to fly a balloon non-stop around the world—simply because it's never been done before. Follow one of the foremost teams in a hair-raising race against time, technology, and hot competition. 1 hr. **WG2313 ~~$19.95~~ $9.95**

NEW! To the Moon

Marking the 30th anniversary of Neil Armstrong's moonwalk, *NOVA* presents this spectacular event exploring the greatest science and engineering adventure of all time, with the people who made it happen. Available Summer '99. 1 hr. **WG2610 ~~$19.95~~ $9.95**

Treasures of the Sunken City

It's an undersea adventure in Cleopatra's erstwhile capital: Alexandria, Egypt, where marine archaeologists are frantically salvaging mysterious stone ruins from the harbor floor. 1 hr. **WG2417 ~~$19.95~~ $9.95**

The Tribe That Time Forgot

NOVA travels deep into the Amazon wilderness in search of a mysterious tribe that dismembered and partially ate three prospectors in 1976. Locating the group, *NOVA* lives with them for three months, gaining insight into the customs and beliefs of a people whose lifestyle has not changed for centuries. *Educational use only.* 1 hr. **WG2115 ~~$19.95~~ $9.95**

Venus Unveiled

Travel with the spacecraft Magellan as it flies by Venus to reveal the planet's true face, one of the most bizarre places in the solar system. *Educational use only.* 1 hr. **WGV2210* ~~$19.95~~ $9.95**

NEW! Volcanoes of the Deep

Join a journey to a little-known realm and witness extraordinary imagery and an exceptional feat of deep sea engineering as several massive underwater volcanoes are brought to the surface. Available Spring '99. 1 hr. **WG2609 ~~$19.95~~ $9.95**

Wanted: Butch and Sundance

Forensic sleuth, Clyde Snow, and a posse of experts travel to Bolivia in search of the remains of Butch Cassidy and the Sundance Kid. They find that Hollywood and legend got a few things wrong. *Educational use only.* 1 hr. **WGW702* ~~$19.95~~ $9.95**

NEW! Warnings From the Ice

Battle extreme weather conditions in Antarctica with *NOVA* scientists as they gather data that will reveal new insight into the nature of global climate change. 1 hr. **WG2508 ~~$19.95~~ $9.95**

Warriors of the Amazon

See a rare glimpse of life today for the Yanomami, who live in a remote and inhospitable part of the Amazon rain forest. 1 hr. **WG2309 ~~$19.95~~ $9.95**

General Science

Anastasia Dead or Alive?

Investigate the massacre of Tsar Nicholas and his family, and evaluate whether modern science has resolved the mystery surrounding Princess Anastasia. 1 hr. **WGA2209 ~~$19.95~~ $9.95**

NEW! Battle Alert in the Gulf

Has US war technology kept pace? Join NOVA and American forces in the Persian Gulf for an unprecedented look at our military—from aircraft carriers and cruisers to submarines and jet fighters. 1 hr. **WG2608 ~~$19.95~~ $9.95** Available Winter '99.

Behind the Scenes with King Kong in Special Effects

Welcome to the wild world of special effects, where anything can happen! *NOVA* takes you behind the scenes as effects experts bring a legend to life in this exclusive look at how King Kong was created for the Oscar®-nominated IMAX film *Special Effects*. 1 hr. **WG093 ~~$12.95~~ $6.50**

The Bermuda Triangle

Join this investigation of the mysterious watery graveyard in the Atlantic. 1 hr. **WGW264 ~~$19.95~~ $9.95**

Dr. Spock The Baby Doc

Witness an absorbing view of one of this century's most influential Americans and his profound impact on changing ideas about child care. *Educational use only.* 1 hr. **WG2308* ~~$19.95~~ $9.95**

NEW! ESCAPE! Because Accidents Happen Boxed Set

Can any good come out of tragedy? In the *Escape!* series, *NOVA* examines the fascinating science of "survival engineering." See how the study of yesterday's accidents helps prevent today's disasters. Includes *Fire, Car Crash, Plane Crash* and *Abandon Ship*. 4 hrs. **WG2666 ~~$49.95~~ $24.95** Available Winter '99.

- **Fire**
  Witness the remarkable story behind such ingenious inventions as the automatic sprinkler, explore man's historic effort to stay safe from fire, and discover the most effective fire survival tactic: prevention. 1 hr. **WG2604 ~~$19.95~~ $9.95** Available Winter '99.
- **Car Crash**
  Automobile safety has come slowly and at the expense of millions of lives. *Crash* focuses on such unheralded automotive safety heroes as the inventors of the seatbelt and airbag. 1 hr. **WG2605 ~~$19.95~~ $9.95** Available Winter '99.
- **Plane Crash**
  Meet the aviators and aero-engineers who risked their lives to avert air disasters. See their revolutionary parachutes, ejection seats, NASA escape systems, and the riveting history of aircraft safety. 1 hr. **WG2606 ~~$19.95~~ $9.95** Available Winter '99.
- **Abandon Ship**
  Trace hundreds of years of maritime safety engineering including the remarkable stories behind the invention of lifejackets, life boats, and many other life-saving technologies. 1 hr. **WG2607 ~~$19.95~~ $9.95** Available Winter '99.

In Search of the First Language

NOVA explores the common threads that link the more than 5000 languages of Earth, including a controversial theory that claims to reconstruct words from a time when only a handful of languages were spoken, recalling the biblical story of the Tower of Babel. *Educational use only.* 1 hr. **WG2120* ~~$19.95~~ $9.95**

The Great Wildlife Heist

NOVA goes undercover with a US government sting that breaks an international parrot smuggling ring, landing some surprising suspects. *Educational use only.* 1 hr. **WG2111* ~~$19.95~~ $9.95**

The KGB, the Computer and Me

NOVA follows computer sleuth Clifford Stoll as he tracks down a data thief through a maze of military and research computers. 1 hr. **WG1710* ~~$19.95~~ $9.95**

NEW! A Man, A Plan, A Canal, Panama

Travel the Panama Canal on a luxury liner with David McCullough as he tells the human drama behind this wonder of the world. 1 hr. **WG1415 ~~$19.95~~ $9.95**

Mysterious Crash of Flight 201

Join in the investigation of a mysterious jetliner crash in Panama. 1 hr. **WGW707 ~~$19.95~~ $9.95**

Nazi Designers of Death

The discovery of top-secret Nazi files reopens a painful chapter in history, revealing the careful planning behind the Nazi death camps. *Educational use only.* 1 hr. **WG2205* ~~$19.95~~ $9.95**

NEW! The Perfect Pearl

Travel with *NOVA* to exotic locations where rare pearls are harvested by divers, and to farms where huge numbers of pearls are grown. Will the cultured pearls ruin the value of those grown in the wild? 1 hr. **WG2507N ~~$19.95~~ $9.95**

The Science of Crime Boxed Set

Serial criminals wield a particular brand of terror. Fortunately for us, scientific sleuths are on their trail. 3-video set includes *The Bombing of America, Mind of a Serial Killer* and *Hunt for the Serial Arsonist*. 3 hrs. **WG164 ~~$49.95~~ $24.95**

- **The Bombing of America**
  Follow investigators using the latest forensic techniques and psychological insights to crack such notorious cases as the World Trade Center and the Unabomber—as well as many lesser-known tragic incidents. 1 hr. **WG2310 ~~$19.95~~ $9.95**
- **Mind of a Serial Killer**
  Follow the FBI's psychological detectives as they race against time to penetrate the mind of a serial killer—and stop him from striking again. 1 hr. **WG1912 ~~$19.95~~ $9.95**
- **Hunt for the Serial Arsonist**
  Trail along with fire sleuths as they discover the mysterious source of a series of L.A. store fires, and capture a surprising suspect filmed by *NOVA*. 1 hr. **WGA2214 ~~$19.95~~ $9.95**

Secrets of Making Money

Learn the secrets of counterfeiting—made easier by today's technology—and find out what the Feds are doing to fight back: a new look for US currency, with layers of security features to keep counterfeiters at bay. 1 hr. **WG2314* ~~$19.95~~ $9.95**

Secrets of the Psychics

Are some of us born with mysterious powers—able to move objects at will, read a person's thoughts, even cure physical ailments with the power of the mind? Follow master magician James Randi as he uncovers the secrets about psychics. 1 hr. **WGW703 ~~$19.95~~ $9.95**

The Shape of Things

Marvel at the endlessly inventive patterns of natural objects like crystals, honeycombs, seashells, eggs and seeds through photomicroscopy, computer animation and time-lapse photography. 1 hr. **WG1206* ~~$19.95~~ $9.95**

NEW! Submarines, Secrets and Spies

America's submerged secrets finally surface! With recently declassified film, *NOVA* lifts the veil on tragic and mysterious submarine accidents and their high-risk spy missions that helped win the Cold War. 1 hr. **WG260 ~~$19.95~~ $9.95**

Terror in the Minefields

Investigate the terror and tragedy of Cambodia's deadly legacy of minefields. 1 hr. **WG2301 ~~$19.95~~ $9.95**

Titanic's Lost Sister

Titanic's sister ship is surrounded by mystery. Search for the wreck of the Britannic and explore the clues as to how it sank. Four years after the Titanic went down, the Britannic sank in just one hour, despite an overhaul to meet post-Titanic standards. 1 hr. **WG2402 ~~$19.95~~ $9.95**

Vikings in America

Five hundred years before Columbus, the Vikings reached North America. Who were the people they met here? What happened when the two worlds collided? Archaeologists are now revealing an extraordinary story of tragedy and triumph. *Educational use only.* 1 hr. **WG2202* ~~$19.95~~ $9.95**

War Machines of Tomorrow

Take a look back at the war technology employed in the Gulf War, "Desert Storm," and preview the military machines of the future. 1 hr. **WG2305 ~~$19.95~~ $9.95**

CC NOVA videos are closed-captioned for the hearing impaired
* no retail packaging

1-800-949-8670 To order, call and mention "NOVA 25"

UFOs Set

Is there life out in the universe? Are there aliens hovering above or even mixing among us? Our fascination with this fundamental question never ends. 2-video set includes *Kidnapped by UFOs* and *UFOs: Are We Alone?*. 2 hrs. **WG082 ~~$29.95~~ $14.95**

- **Kidnapped by UFOs**
  Delve into this remarkable phenomenon, hear eyewitness accounts and learn what lies behind the incredible claims of UFO abductions. 1 hr. **WG2306 ~~$10.95~~ $9.95**
- **UFOs: Are We Alone?**
  Using rare UFO footage, *NOVA* investigates the claims of sightings. 1 hr. **WGW262 ~~$10.95~~ $9.95**

Life Science

All-American Bear

Share a year in the life of the North American black bear—mating, playing, foraging for food, and hibernating. 1 hr. **WG1520* ~~$10.95~~ $9.95**

NEW! Animal Hospital

Go behind the scenes for this offbeat, sometimes humorous, sometimes sad portrait of pets, their owners and their vets. From racehorses under the knife for cancer, to Manhattan hounds on Prozac, you'll view the mini-dramas that unfold everyday in homes, zoos and veterinary hospitals. 1 hr. **WG2504 ~~$10.95~~ $9.95**

Animal Imposters

A gnarled twig. A stretch of sand. A shadow. Suddenly they twitch—or lunge—and you realize you've been taken in by a cleverly disguised animal. 1 hr. **WG909* ~~$10.95~~ $9.95**

NEW! The Brain Eater

Highly infectious and incurable, "mad cow disease" has claimed the lives of nearly a million cattle in Britain. Scientists race to determine whether a variant of the disease spells a deadly epidemic for humans. *Educational use only.* 1 hr. **WG2505* ~~$10.95~~ $9.95**

NEW! Brain Transplant

NOVA follows a remarkable, little-known medical detective story, leading from an inexplicable paralysis among drug abusers, to a bad batch of synthetic heroin, to a research breakthrough in understanding Parkinson's Disease, to the prospect of curing brain diseases with fetal implants. *Educational use only.* 1 hr. **WG1918* ~~$10.95~~ $9.95**

Can Buildings Make You Sick?

Join the quest to uncover baffling cases of bad air found in offices, schools, homes and even hospitals! *Educational use only.* 1 hr. **WG2217* ~~$10.95~~ $9.95**

City of Coral

Dive into the beauty and wonder of a Caribbean coral reef. 1 hr. **WG1006* ~~$10.95~~ $9.95**

Coma

In a gripping real-life drama, *NOVA* follows famous neurosurgeon Jam Ghajar as he struggles to save a young boy with massive head trauma, using simple but crucial techniques that are dangerously absent from most hospitals across the country. 1 hr. **WG2411 ~~$10.95~~ $9.95**

Creatures of the Sea Set

Experience the undersea beauty of the Pacific Ocean. 2-video set includes *Treasures of the Great Barrier Reef* and *Kingdom of the Seahorse*. 2 hrs. **WG738 ~~$29.95~~ $14.95**

- **Treasures of the Great Barrier Reef**
  Swim through a day in the life of Australia's greatest natural wonder, and view the undersea world's brilliant colors and extraordinary inhabitants. 1 hr. **WG2215 ~~$10.95~~ $9.95**
- **Kingdom of the Seahorse**
  Discover this remarkable fish whose male becomes pregnant and gives birth. Tour the magical and complex world of the seahorse—from an underwater enclave in Australia to a village in the Philippines dependent on the seahorse for survival. 1 hr. **WG2410 ~~$10.95~~ $9.95**

Cut to the Heart

Can a radical form of surgery from the jungles of Brazil save desperately ill heart-disease patients? Watch this cutting-edge procedure in action—and listen to the stories of those whose lives it has renewed. 1 hr. **WG2409 ~~$10.95~~ $9.95**

Ebola: The Plague Fighters

The Ebola virus and its devastating impact is profiled as *NOVA* travels behind the quarantine line to observe the scientists battling to contain this most deadly of viruses. 1 hr. **WG2304 ~~$10.95~~ $9.95**

Haunted Cry of a Long Gone Bird

NOVA explores the legacy of the great auk, a magnificent flightless bird that was hunted to extinction over a century ago. *Educational use only.* 1 hr. **WG2113* ~~$10.95~~ $9.95**

Life's First Feelings

Look close-up with researchers to understand babies' emotional responses, clues about developing personality traits and how parents help with socialization. 1 hr. **WGS304* ~~$10.95~~ $9.95**

Little Creatures Who Run the World

Peer close-up into the worlds of the most amazing ants and understand why some believe ants are the most successful life form on earth. 1 hr. **WG2203 ~~$10.95~~ $9.95**

MD: The Making of a Doctor

Check up on seven aspiring doctors as they undergo the exhilarating and rigorous years of medical training. 2 hrs. **WG2207 ~~$10.95~~ $9.95**

Mystery of the Animal Pathfinders

Travel to bird feeding grounds in Brazil, bat caves in Mexico and eel habitats in Maine to understand the mystery of animal migration. 1 hr. **WGW710* ~~$10.95~~ $9.95**

NEW! Night Creatures of the Kalahari

Discover bush babies, meerkats, striped polecats, brown hyenas, flying termites, and many more rarely seen exotic creatures. 1 hr. **WG2501 ~~$10.95~~ $9.95**

The Private Lives of Dolphins

Discover the deep-sea drama of life for the ocean's most charming and sophisticated mammals. 1 hr. **WG1917* ~~$10.95~~ $9.95**

Rescuing Baby Whales

Join the dramatic rescue of young, stranded pilot whales, and learn what is behind this puzzling phenomenon. 1 hr. **WG1908* ~~$10.95~~ $9.95**

Shadow of the Condor

NOVA soars with the condor, an extraordinary bird that lives a tenuous existence in the California mountains and the Andes of South America. *Educational use only.* 1 hr. **WGW705* ~~$10.95~~ $9.95**

Shark Attack!

Are sharks developing a taste for human flesh? A rash of shark attacks off Hawaii spurs a team of researchers to track the predators' elusive movements—and the scientists discover some surprising truths about the way sharks kill. 1 hr. **WG2316 ~~$10.95~~ $9.95**

NEW! Surviving AIDS

Between life and death lies hope. This eye-opening special combines the most promising research with compelling human stories of patients and doctors devoted to unraveling one of the most complicated mysteries in scientific history. 1 hr. **WG2603 ~~$10.95~~ $9.95** Available Winter '99.

The Wonder of Life Boxed Set

Hidden from the human eye, the wonder of life unfolds in, on and around us with startling beauty and unexpected drama. 4-video set includes *The Odyssey of Life Set (The Ultimate Journey, The Unknown World, The Photographer's Secrets)* and *The Miracle of Life*. 4 hrs. **WG177 ~~$59.95~~ $29.95**

SAVE 50% on orders received by 6/30/99

- **The Odyssey of Life Set**
  Travel with the creator of *The Miracle of Life* into the mysterious and previously invisible world inside our bodies. The 3-video set includes *The Ultimate Journey, The Unknown World* and *The Photographer's Secrets*. 3 hrs. **WGB2317 ~~$49.85~~ $24.95**

- **The Ultimate Journey**
  Stunning microphotography by Lennart Nilsson shows how the developing human embryo reveals links to other species—reflecting a shared ancestry that harks back to the dawn of creation. 1 hr. **WG2317 ~~$19.95~~ $9.95**

- **The Unknown World**
  They're hiding in your closet. They're lurking in your bed. They're all over you—and now, thanks to the microphotography of Lennart Nilsson, you can catch these creepy crawlers in the act, magnified to monster size. 1 hr. **WG2318 ~~$19.95~~ $9.95**

- **The Photographer's Secrets**
  For the first time ever, Lennart Nilsson—the photographer who led us into the awe-inspiring world of the womb—reveals his secret state-of-the-art microphotographic techniques. 1 hr. **WG2319 ~~$19.95~~ $9.95**

- **The Miracle of Life**
  This Emmy* award-winning classic brings you along on an incredible microphotographic voyage through the human body as a new life begins, including the moment of conception. 1 hr. **WG001 ~~$19.95~~ $9.95**

Mystery of the Senses Boxed Set

Enjoy a celebration of the senses— a vivid blend of science and imagery. 5-video set includes *Hearing, Smell, Taste, Touch* and *Vision*. 5 hrs. **WG2214† ~~$69.95~~ $34.95**

- **Hearing**
  Visit the quietest place on earth, the music-rich Maori and a deaf woman regaining her hearing. 1 hr. **WG2209† ~~$19.95~~ $9.95**

- **Smell**
  Sample a huge spectrum of smells, from the world's largest perfumery to sweaty t-shirts. 1 hr. **WG2210† ~~$19.95~~ $9.95**

- **Taste**
  Savor the miracle of great cooking and eating. 1 hr. **WG2211† ~~$19.95~~ $9.95**

- **Touch**
  Discover how touching is a potent tonic. 1 hr. **WG2212† ~~$19.95~~ $9.95**

- **Vision**
  Explore how art and science enhance this, our most magical sense. 1 hr. **WG2213† ~~$19.95~~ $9.95**

Secret of the Wild Child

NOVA profiles "Genie," a girl whose parents kept her imprisoned in near total isolation from infancy. Includes footage of Genie during her rehabilitation and probes how and when we learn the skills that make us "human." *Educational use only.* 1 hr. **WG2112* ~~$19.95~~ $9.95**

Siamese Twins

Witness the intricate plans and delicate operations that give independence to two young girls who were born joined at the pelvis. 1 hr. **WG2204* ~~$19.95~~ $9.95**

Stranger in the Mirror

NOVA explores the nature of human perception through the puzzling condition called visual agnosia, the inability to recognize faces and familiar objects, made famous in Oliver Sacks' book, *The Man Who Mistook His Wife for a Hat*. *Educational use only.* 1 hr. **WG709* ~~$19.95~~ $9.95**

NEW! The Truth About Impotence

NOVA offers a revealing look at erectile dysfunction: its causes, its life-shattering effects, and the amazing progress science has made in treating it over the last 20 years. 1 hr. **WG2510 ~~$19.95~~ $9.95**

The Universe Within

Travel inside the human body, with microphotography and computer animation achieved by the creators of *The Miracle of Life*. Witness the miracle of pregnancy, the travels of a PB&J sandwich, and the amazing mechanism of movement. 1 hr. **WG2206 ~~$19.95~~ $9.95**
Also available, 90-min. educational-use-only version.
WG2206A ~~$19.95~~ $9.95

What's New About Menopause

Examine new research and medical capabilities that stir up ethical controversies over the new ability to postpone menopause or bear children after "the change." 1 hr. **WG2114 ~~$19.95~~ $9.95**

Physical Science

Avalanche!

With no warning and in mere seconds, an avalanche wipes out everything in its path, killing hundreds of people each year. See what risks scientists are taking to protect us. 1 hr. **WG2418N ~~$19.95~~ $9.95**

NEW! The Beast of Loch Ness

Is the Loch Ness monster a fable, a species unknown to science, or a long-extinct reptilian cousin of the dinosaur? Join noted sonar pioneer Dr. Robert Rines and his team of undersea experts to determine whether "Nessie" is a great beast... or a great hoax. 1 hr. **WG2601 ~~$19.95~~ $9.95**

The Best Mind Since Einstein

A profile of the late Richard Feynman—atomic bomb pioneer, Nobel prize-winning physicist, acclaimed teacher and all-around eccentric—who helped solve the mystery of the space shuttle Challenger explosion. *Educational use only.* 1 hr. **WGW708* ~~$19.95~~ $9.95**

Bomb Squad

A former IRA member reveals some of the organization's most chilling tactics as *NOVA* looks at the British Army's latest technological advances—in which science and ingenuity are the key to survival. 1 hr. **WG2413 ~~$19.95~~ $9.95**

Einstein Revealed

Journey into the life and thoughts of a genius—through interviews with "Einstein" (Andrew Sachs of *Fawlty Towers*), insight from experts, and some whimsical computer animation. 2 hrs. **WG2311* ~~$19.95~~ $9.95**

Fast Cars

The exhilaration of speed meets the challenges of aerodynamic design as champion driver Bobby Rahal and a team of experts race to ready his custom car for the Indianapolis 500. 1 hr. **WG2208 ~~$19.95~~ $9.95**

Faster Than Sound

The international race to build an aircraft that could crack the sound barrier was fraught with danger, ambition, and intrigue. *NOVA* tells the real story of those who risked all to make aviation history—including Chuck Yeager, who on October 14, 1947 was the first pilot to fly faster than sound. 1 hr. **WG2412 ~~$19.95~~ $9.95**

Flying the Blimp

Revisit the giant airships that ruled the skies—before the Hindenburg disaster dashed their promise—and find out how latter-day blimp builders are resurrecting these romantic lighter-than-air machines. 1 hr. **WG1714 ~~$19.95~~ $9.95**

Kaboom!

Experience the ultimate chemical reaction—the explosion. With high speed photography and dramatic reconstructions, *NOVA* examines the history of explosives and their role in accidents, war and terrorism. 1 hr. **WG2401 ~~$19.95~~ $9.95**

The Light Stuff

Reliving a Greek myth takes an effort of mythic proportions, as *NOVA* reveals in its behind-the-scenes report of the recent human-powered flight across the Aegean Sea. *Educational use only.* 1 hr. **WGW711* ~~$19.95~~ $9.95**

Race to Catch a Buckyball

Learn about the chance discovery of an entirely new form of carbon—soccer-ball-shaped miraculous molecules called Buckyballs. *Educational use only.* 1 hr. **WG2216* ~~$19.95~~ $9.95**

CC NOVA videos are closed-captioned for the hearing impaired.
* no retail packaging
† public performance rights are not included

1-800-949-8670 to order, call and mention "NOVA 25"

SAVE 50% on orders received by 6/30/99

Physical Science, cont'd.

Roller Coaster!

NOVA takes viewers on the ride of their lives as it explores the science of roller coasters, where physics and psychology meet. New rides of the future may take place entirely in the mind—with virtual reality. *Educational use only.* 1 hr. **WGW706* ~~$10.95~~ $9.95**

Secrets of Lost Empires Boxed Set

Uncover the secrets of ancient civilizations as *NOVA* journeys to five archaeological sites where teams of experts use traditional techniques to test their hypotheses. 5-video set includes *Colosseum, Inca, Obelisk, Stonehenge* and *Pyramid*. 5 hrs. **WG182 ~~$60.95~~ $34.95**

- **Colosseum**
  Try out two possible designs for the canopy that once covered the Colosseum—one of them borrowed from ancient ships. 1 hr. **WG2406 ~~$10.95~~ $9.95**
- **Inca**
  Explore the magnificent mountainside citadels—and marvel as villagers create a 150-foot suspension bridge using nothing but grass. 1 hr. **WG2404 ~~$10.95~~ $9.95**
- **Obelisk**
  Face the challenge of quarrying, chiseling, hauling, and mounting an obelisk—using stones, ropes, logs, and dirt. 1 hr. **WG2405 ~~$10.95~~ $9.95**
- **Stonehenge**
  Watch a band of experts move, raise, and cap a structure like the mysterious Stonehenge—armed with Stone Age tools. 1 hr. **WG2403 ~~$10.95~~ $9.95**
- **Pyramid**
  Join the race to erect an 18-foot stone pyramid in three weeks—while testing out some clever construction theories. 1 hr. **WG181 ~~$10.95~~ $9.95**

Super Bridge

Take a look at "the bridge of the future" and play sidewalk supervisor on one of the world's most remarkable and risky bridge projects—the building of the elegant, cable-stayed Clark Bridge spanning the Mississippi at Alton, Illinois. 2 hrs. **WG2416 ~~$10.95~~ $9.95**

NEW! Supersonic Spies

This true tale of cold war espionage tells the shocking details of the race for supersonic passenger travel. 1 hr. **WG2503 ~~$10.95~~ $9.95**

This Old Pyramid

Join an Egyptologist as he reveals the secrets of the ancient pyramids and advises a stonemason from *This Old House* on how to build a new pyramid. 90 min. **WGW278 ~~$10.95~~ $9.95**

The Thrill of Flight Set

Take a rare opportunity to fly in some of the world's most fascinating airplanes. 3-video set includes *Aircraft Carrier!, Daredevils of the Sky* and *B-29 Frozen in Time*. 3 hrs. **WG163 ~~$49.95~~ $24.95**

- **Aircraft Carrier!**
  The grueling, yet suddenly thrilling life aboard the USS Independence. 1 hr. **WGW2110 ~~$10.95~~ $9.95**
- **Daredevils of the Sky**
  Strap in for a ride with America's greatest stunt pilots. Stunning in-air photography puts you in the pilot's seat with the US Aerobatic Team. 1 hr. **WGW2103 ~~$10.95~~ $9.95**
- **B-29 Frozen in Time**
  Join a grueling expedition to recover this rare plane from the North Pole after 50 years—a trip which tests team members in ways they never imagined. 1 hr. **WG2303 ~~$10.95~~ $9.95**

Top Gun Over Moscow

For half a century we feared them. Now, for the first time, meet the rugged pilots of the Russian Air Force—and take a close-up look at the heart-stopping maneuvers that still fill Western flyers with awe. 1 hr. **WG2315 ~~$10.95~~ $9.95**

Mathematics

Chip vs. the Chessmaster

NOVA explores what it took to prepare Deep Thought, a computer chess program, to take on world champion Gary Kasparov in 1989. *Educational use only.* 1 hr. **WG1803* ~~$10.95~~ $9.95**

Codebreakers

NOVA delves into the history of secret communications and the people who decipher them, probing the most celebrated of all cryptographic coups: the breaking of the World War II codes used by Japan and Germany. *Educational use only.* 1 hr. **WGW2101* ~~$10.95~~ $9.95**

NEW! The Proof

Eureka! Follow Princeton math whiz Andrew Wiles, who spent eight secluded years perfecting the proof of Fermat's Last Theorem, a famous enigma that had stumped experts for 300 years. *Educational use only.* 1 hr. **WG2414* ~~$10.95~~ $9.95**

NOVA Classroom Field Trips

Amazing Animals

Meet some extraordinary animals around the world—from bugs to bats and more. Includes *All-American Bear, Little Creatures Who Run the World* and *Mystery of the Animal Pathfinders*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG089 ~~$49.95~~ $24.95**

Creatures of the Sea

Dive deep for an underwater visit with the ocean's most fascinating creatures. Includes *Shark Attack!, Private Lives of Dolphins* and *Treasures of the Great Barrier Reef*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG091 ~~$49.95~~ $24.95**

Dinosaurs

Join scientists in a dig for clues about the world of dinosaurs. 3-video set includes *Buried in Ash, Dinosaurs of the Gobi*, and *Mammoths of the Ice Age*. Teacher's guide included. *Educational use only.* 3 hrs. on 3 cassettes. **WG094 ~~$49.95~~ $24.95**

The Discoverers

Take a close look at the century's great scientists and learn how they made their breakthrough discoveries. Includes *Einstein Revealed* (2 hrs.) and *Race to Catch a Buckyball*. Teacher's guide included. *Educational use only.* 3 hrs. on 2 cassettes. **WG106 ~~$49.95~~ $24.95**

Discovering Ancient Cultures

Science provides new clues about some of the world's most interesting ancient cultures. Includes *This Old Pyramid* (90 min.), *Vikings in America*, and *Warriors of the Amazon*. Teacher's guide included. *Educational use only.* 3.5 hrs. on 3 cassettes. **WG092 ~~$49.95~~ $24.95**

The Doctors

See how doctors operate behind the scenes. Grades 7 and up. Includes *MD: The Making of a Doctor* (2 hrs.) and *Ebola: The Plague Fighters*. Teacher's guide included. 3 hrs. on 2 cassettes. **WG104 ~~$49.95~~ $24.95**

The Earth

Take a close-up look at some of Earth's most spectacular phenomena. Includes *In the Path of a Killer Volcano, The Day the Earth Shook* and *Flood!* Teacher's guide included. 3 hrs. on 3 cassettes. **WG110 ~~$49.95~~ $24.95**

Exploring Space

View the universe from new perspectives. Includes *Countdown to the Invisible Universe, Death of a Star* and *Rescue Mission in Space*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG107 ~~$49.95~~ $24.95**

Fast Physics

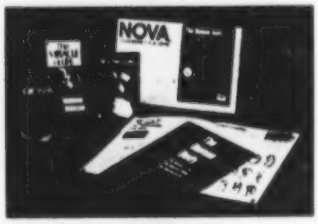
Understand the thrill and power of motion. Includes *Roller Coaster!, Fast Cars* and *Daredevils of the Sky*. Teacher's guide included. *Educational use only.* 3 hrs. on 3 cassettes. **WG086 ~~$49.95~~ $24.95**

Flight

Feel the exuberance and the thrill of flight—in a classic plane, fast planes, and a balloon. Includes *Top Gun Over Moscow, Three Men and a Balloon* and *Aircraft Carrier!*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG111 ~~$49.95~~ $24.95**

The Human Body

The intricate wonders of the human body are revealed in extraordinary visual detail. Includes *The Miracle of Life, The Universe Within* and *The Ultimate Journey*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG085 ~~$49.95~~ $24.95**



In Search of Human Origins

View the award-winning exploration of the beginnings and development of the human race. Includes *The Story of Lucy, Surviving in Africa* and *The Creative Revolution*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG109 ~~$49.95~~ $24.95**

The Mysteries of the Mind

Explore the intriguing phenomena of perception, psychological development, and reports of alien abductions. Includes *Kidnapped by UFOs, Secret of the Wild Child*, and *Stranger in the Mirror*. Teacher's guide included. *Educational use only*. 3 hrs. on 3 cassettes. **WG105 ~~$49.95~~ $24.95**

The Planets, The Stars and More

Visit some of the most extraordinary places in the universe. Includes *Venus Unveiled, Eclipse of the Century* and *Doomsday Asteroid*. Teacher's guide included. *Educational use only*. 3 hrs. on 3 cassettes. **WG087 ~~$49.95~~ $24.95**

Scientific Detectives

Team up with scientists as they search for answers to intriguing mysteries. Includes *Codebreakers, Hunt for the Serial Arsonist* and *In Search of the First Language*. Teacher's guide included. *Educational use only*. 3 hrs. on 3 cassettes. **WG090 ~~$49.95~~ $24.95**

Secrets of Lost Empires

Travel to five archaeological sites with *NOVA* and their teams of experts. The mission? To replicate ancient engineering feats—using traditional tools. Includes *Stonehenge, Inca, Obelisk, Colosseum* and *Pyramid*. Teacher's guide included. 5 hrs. on 5 cassettes. **WG304 ~~$69.95~~ $34.95**

Wild Weather

Join "stormchasers" on a journey into danger to learn how to tame nature's fury. Includes *Lightning!, Tornado!* and *Hurricane!*. Teacher's guide included. 3 hrs. on 3 cassettes. **WG088 ~~$49.95~~ $24.95**

NOVA Video Toy Kits

Ants!

Look close-up at the world's most intriguing ants, then be a naturalist with the Uncle Milton's Ant Farm and guide included in the set. Includes *Little Creatures Who Run the World*. 1 hr. **WG9203 ~~$19.95~~ $9.95**

Flying!

Take a thrilling ride with America's best stunt pilots, then be a pilot with the three Whitewings stunt airplanes and guide included in the set. Includes *Daredevils of the Sky*. 1 hr. **WG9103 ~~$19.95~~ $9.95**

Our Ancestors!

Solve the puzzle of the "missing link" between humans and apes, then be an anthropologist with the Skilcraft skeleton model and guide included in the set. Includes *The Story of Lucy*. 1 hr. **WG9106 ~~$19.95~~ $9.95**

Pyramid!

Explore the mysteries of the ancient pyramids of Egypt, then be an Egyptologist with the 3-D pyramid puzzle and guide included in the set. Includes *This Old Pyramid*. 90 min. **WG9278 ~~$19.95~~ $9.95**

CC NOVA videos are closed-captioned for the hearing impaired

• no retail packaging

† public performance rights are not included

NOVA is a trademark of the WGBH Educational Foundation
©1998 WGBH Educational Foundation

Ordering Information

Phone

Call 1-800-949-8670, and mention "NOVA 25" for your special 50% off discount (8 AM to 3 AM, EST, 7 days a week). Offer good through 6/30/99. Please have your American Express, VISA, MasterCard or Discover card ready.

Fax

Fax your order with credit card payment or purchase order to: Dept. NOVA 25 1-802-864-9846

Mail

Mail your order with credit card payment or purchase order to NOVA Videos, PO Box 2284 NOVA 25, South Burlington, VT 05407-2284

Shipping

Videos will arrive within two weeks from date of order if items are in stock. Back-ordered items take 4-6 weeks. Shipping and handling charges for videos sent to the same address are as follows: $3.95 for the first video, $1.00 for each additional video; $6.95 for the first Classroom Field Trip, $2.00 for each additional Field Trip. Rush and overnight delivery can be arranged at an additional charge. Sales tax applies on NY, CA, MA (5%) and VT (5%) orders.

Your purchase helps support public television.

Visit us at www.wgbh.org

BEST COPY AVAILABLE

1-800-949-8670 To order, call and mention "NOVA 25"

Ordering Guides & Transcripts

Guides

To be placed on our mailing list to receive a **free subscription** to the semiannual *NOVA Teacher's Guide*, send us a note with your name, address, **and the grades and subjects you teach** to:

NOVA Teacher's Guide
WGBH, 125 Western Avenue
Boston, MA 02134
E-mail:
WGBH_Materials_Request@wgbh.org

Transcripts

Full transcripts of NOVA programs airing after January 7, 1997, are available on NOVA's Web site at:
http://www.pbs.org/nova/transcripts

Transcripts of shows airing before that date are available for purchase by calling (800) ALL-NEWS.

Taping Rights

All new NOVA programs may be used for one year from their broadcast date. (See Contents & Broadcast Schedule, page 1, for any exceptions.)

Credits

The *NOVA Teacher's Guide* is produced by the Educational Print and Outreach department of the WGBH Educational Foundation.

Director of Educational Outreach
Beth Kirsch

Associate Director of Educational Print and Outreach
Karen Barss

Manager of Educational Print
Sonja Latimore

Project Director
Karen Hartley

Associate Editor
Jennifer Lisle

Assistant Editor
Amy Kittenplan-Hubbard

Writers
Luann Colombo
Kristina Ransick
Belinda Recio

Curriculum Consultants
Candace Dunlap, Science Department, Malden Public Schools, Malden, MA
Reen Gibb, Science Department, Brookline Public Schools, Brookline, MA
Hollington Lee, Science Department, West Springfield High School, West Springfield, MA
Maxine Rosenberg, Science Department, Newton Public Schools, Newton, MA

Designers
Tong-Mei Chan, Margaret Jeschke, Douglass Scott

Photo Researcher
Deborah Paddock

Illustrators
Steve Stankiewicz, Rose Zgodzinski

Print Production
Lenore Lanier

The NOVA television series is produced by WGBH Boston, which is solely responsible for its content, and distributed by the Public Broadcasting Service.

Major funding for NOVA is provided by

PARK FOUNDATION

Northwestern Mutual Life®
The Quiet Company®

omega

Copyright © 1999 WGBH Educational Foundation

NOVA is a trademark and service mark of the WGBH Educational Foundation.

Excerpts from the **National Science Education Standards** reprinted with permission from NSES. Copyright 1996 by the National Academy of Sciences. Available from the National Academy Press, 2101 Constitution Ave, N.W., Lockbox 285, Washington, DC 20055.

Permission is granted for reproduction of this printed material by schools and libraries for educational use only.

All other rights reserved. Other than as discussed above, no part of the *NOVA Teacher's Guide* may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the WGBH Educational Foundation, 125 Western Avenue, Boston, MA 02134.

Closed captioned for viewers who are deaf or hearing impaired.

CC

Photography
Cover, NIBSC/Science Photo Library/Photo Researchers, Inc.; Pages 1–5, 40 (background) NASA; page 5 (class) Brian Mayton; pages 6–9 (background) © CNRI/Science Photo Library/Photo Researchers, Inc.; page 6 (HIV) Bo Veisland, MI & I/Science Photo Library/Photo Researchers, Inc.; pages 10–13 (background) Monika Andersson; pages 14–17 (background) © Nathan Benn/Stock, Boston; page 14 (firefighter) Rosenfeld Images Ltd./Science Photo Library/Photo Researchers, Inc.; pages 18–23 (background) © Steve Allen/Peter Arnold, Inc.; page 18 (crash) AP/Wide World Photos; pages 24–27 (background) © Fred McConnaughey/Science Source/Photo Researchers, Inc.; page 24 (vents) B. Murton/Southampton Oceanography Centre/Science Photo Library/Photo Researchers, Inc.; pages 28–31 (background and fetus) © Lennart Nilsson.

Cover: Colored scanning electron micrograph shows lumpy surface of an infected helper T cell (blue). Small spherical HIV particles (red) seen on the cell's surface are budding away from the cell.

Feedback

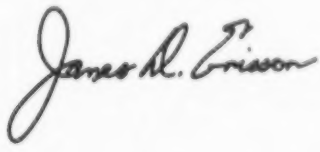
We'd like to know what you think about NOVA, this *Teacher's Guide* and our online activities. Please write to us at:

Jenny Lisle
WGBH
125 Western Avenue, Boston, MA 02134
E-mail: Jenny_Lisle@wgbh.org

As an educator, you deal with the future on a daily basis. More than that – you deal with it on a first-name basis. Every Lisa and Michael and Maria and Tyrone is a representative of future generations to be touched and inspired by your gift for teaching.

I understand how important you are to the future. Because at Northwestern Mutual Life, the future is our business, too: every day, we're helping people make personal and financial plans that will serve them well throughout their lives.

From one future-watcher to another, it is a pleasure to present you with the spring issue of the NOVA Teacher's Guide. I think you'll find this season's offerings to be rich with stimulating material for your classroom. And as proud sponsors of this award-winning educational television series, everyone here at Northwestern Mutual Life thanks you for your dedication to shaping the future.



James D. Ericson
President and Chief Executive Officer

Northwestern Mutual Life®
The Quiet Company®
The Northwestern Mutual Life Insurance Company, Milwaukee, WI

NOVA Teacher's Guide
125 Western Avenue
Boston, MA 02134

WGBH

Nonprofit Organization
U.S. Postage
Paid
Boston, MA
Permit No. 51738

Special One-Time Offer:
NOVA Videos — 50% Off

Celebrating NOVA's 25th Anniversary, page 4

Major funding is provided by PARK FOUNDATION, Northwestern Mutual Life

BEST COPY AVAILABLE